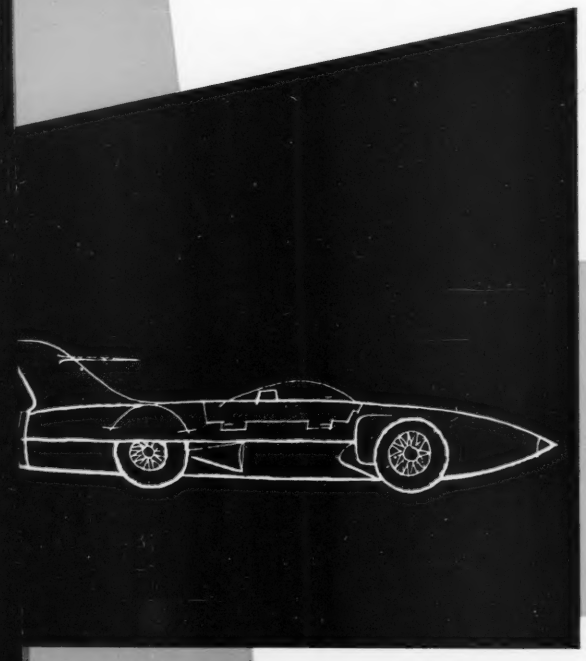
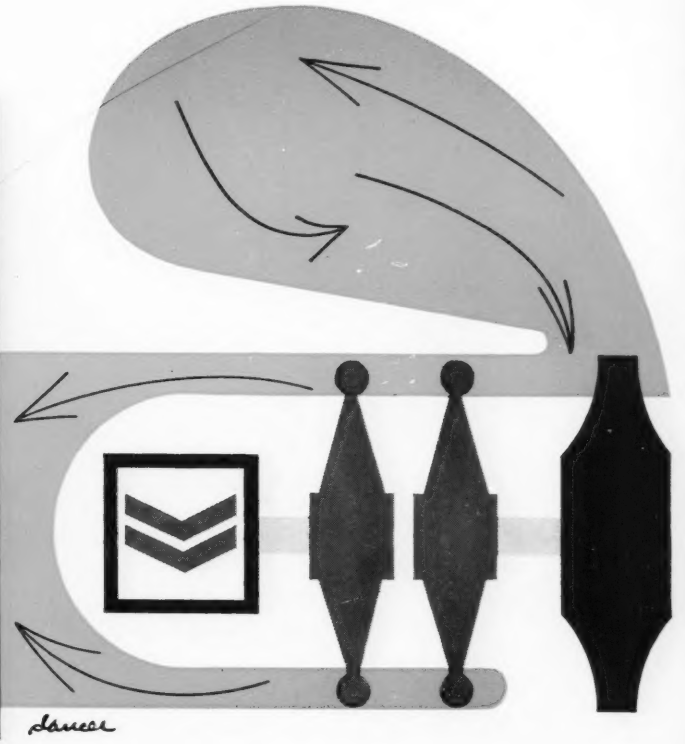
Design Engineering

FIVE DOLLARS A YEAR

FEB 6 19





THE GAS TURBINE COMES TO AUTOMOBILES (page 27)

Cross examine noise with electronics

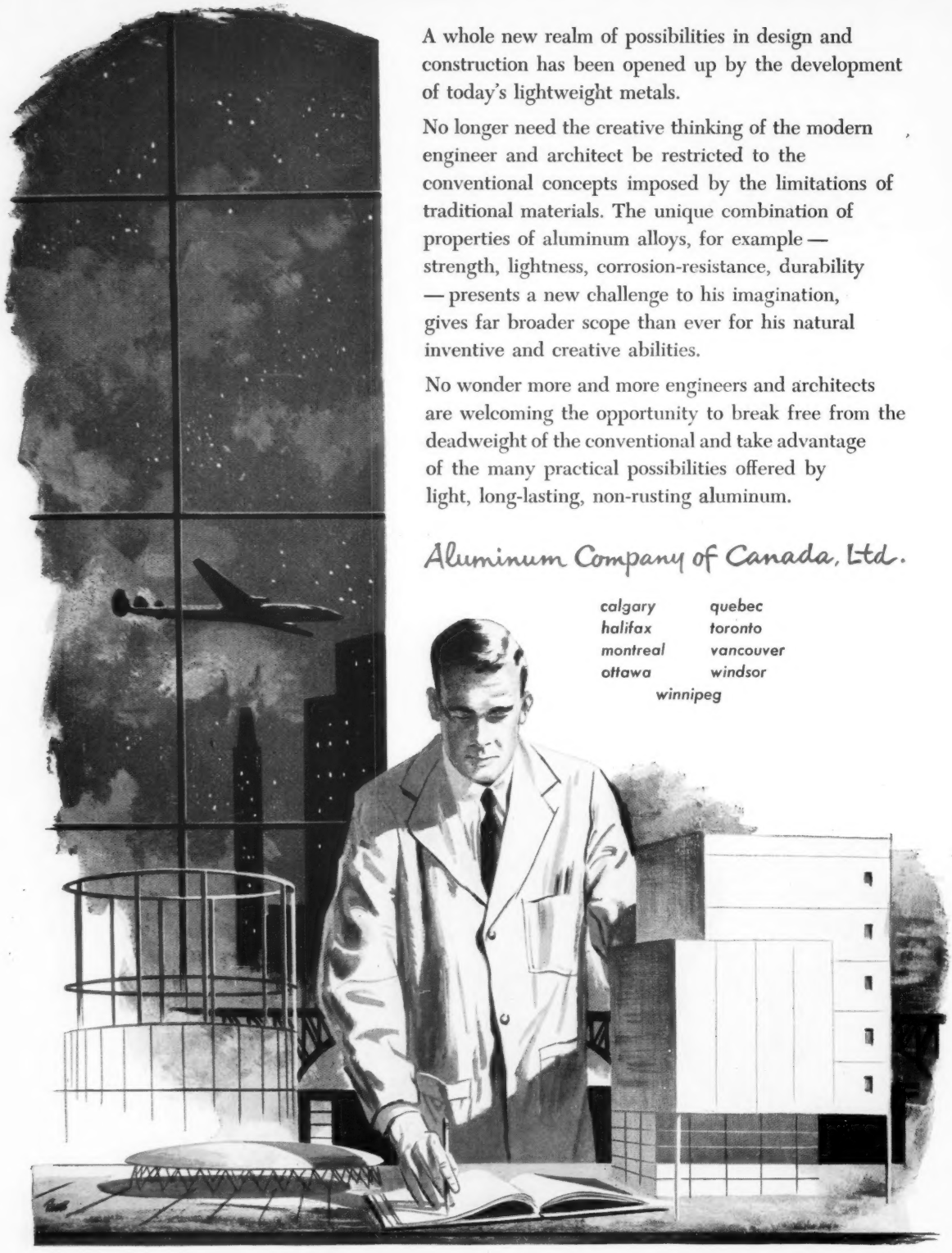
Shell mold replaces machining

Bond aluminum to steel with Al-Fin

March 1956

PUBLISHED BY MACLEAN-HUNTER PUBLISHING COMPANY, LIMITED, TORONTO, CANADA

Breaking free from the fetters of convention



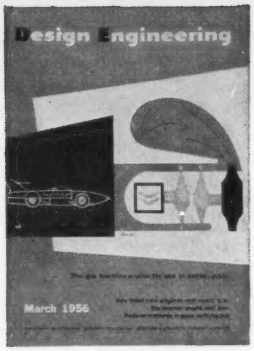
A whole new realm of possibilities in design and construction has been opened up by the development of today's lightweight metals.

No longer need the creative thinking of the modern engineer and architect be restricted to the conventional concepts imposed by the limitations of traditional materials. The unique combination of properties of aluminum alloys, for example — strength, lightness, corrosion-resistance, durability — presents a new challenge to his imagination, gives far broader scope than ever for his natural inventive and creative abilities.

No wonder more and more engineers and architects are welcoming the opportunity to break free from the deadweight of the conventional and take advantage of the many practical possibilities offered by light, long-lasting, non-rusting aluminum.

Aluminum Company of Canada, Ltd.

calgary *halifax* *montreal* *ottawa* *quebec* *toronto* *vancouver* *windsor* *winnipeg*



Design Engineering

VOL. 2 MARCH 1956 NO. 3

This month's cover

Abstractly conceived by artist Don Dancer, the main elements of the gas turbine engines used experimentally in cars is illustrated on the cover. The compressor mid-page right produces the compressed air which blobs off to left. Two diamond-like turbines in the engine are connected to the compressor and the gears. Although the cover design is exaggerated to highlight some components, in reality an engine based on these concepts powers the Firebird on cover's left.

Design Engineering

MEMBER

CCAB

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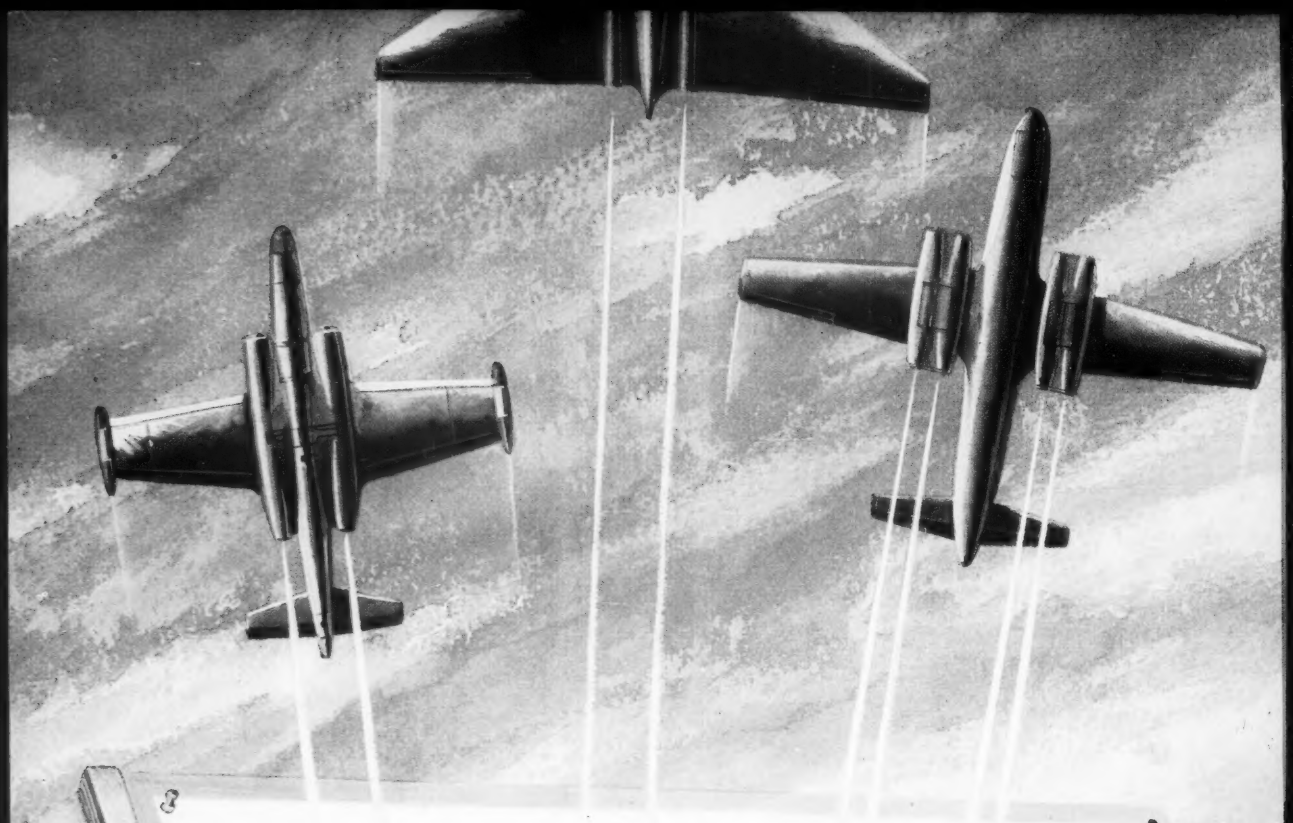

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that became real serviceable aircraft — the CF-100,
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the new secret supersonic interceptor — all this
in the short dramatic period of ten years.
The research, engineering and production
resources of Avro Aircraft form the nucleus of
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the supersonic demands of tomorrow.

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1945—10 YEARS OF JETPOWERED AERONAUTICAL DEVELOPMENT FOR CANADA—1955

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The **April** issue of **Design Engineering** will carry strong feature articles written by contributors no less experienced than those featured this month.

Electrostatic Spraying — telling what the process is and how it is helping design engineers will be the subject of our lead feature for next month, as well as the basis for our cover.

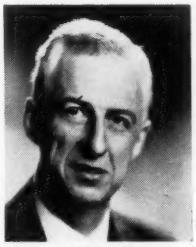
Nylon Zytel, which is being used more and more in mechanical parts such as gears, will be covered in another well-researched story.

And from France via an English correspondent we will bring our readers an exciting article about the Free-Piston Engine.

Special Artwork

Editorial layouts designed by art consultant **Desmond English.**

Inside



Biggar

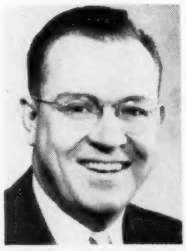
This is the second time that Percival Biggar's picture has been seen on this page. The first occasion (August 1955) as a result of his article "You should sell management on coming products, ideas," and again this month in connection with his dynamic story on gas turbine cars (page 27). Greying Biggar has made a beneath-the-surface study of what is going on in turbine research by leading motor car manufacturers in North America and in England. The editors think he has come up with a compelling article presenting many little known facts on what has been happening to turbines in cars.

Crusey

An Al-Fin applications engineer, Howard Crusey, is responsible for developing new applications for the company process (see page 38). He has done this by maintaining close contact with design, development and research engineers across the U. S. and Canada. A World War II Army Ordnance Officer, engineer Crusey is a Michigan University graduate.

Rybb

A lover of operatic and classical music, S. A. Rybb, author of Noise Measurement (page 42) emigrated to Canada in 1954 to join the newly established division of Dawe Instruments Ltd. Since graduation from London University in electrical engineering —1949—he worked with the parent Dawe company. Of Polish origin, engineer Rybb served with the Allied Armed Forces as a Technical Officer. Married, with one daughter, he is 34.



Bolt

Jack Bolt, who wrote the article on Shell Molding (page 32), attended the U. S. Naval Academy Midshipman School for engineers, Georgia Tech and Alabama University. As a result he has two degrees, one in mechanical engineering and the other in metallurgical engineering. A technical service engineer in the foundry resins division of the General Electric Company, southern-born Bolt is married and has three children. He resides with his family in Pittsfield, Mass.

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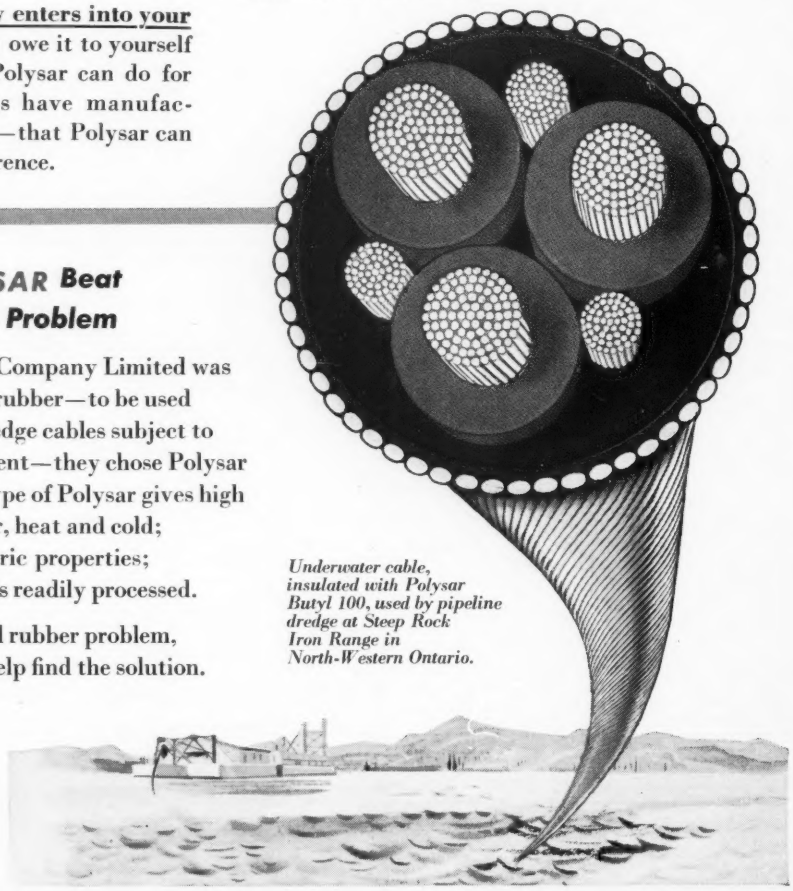
Can POLYSAR Bring to Life Your Product Ideas?

Yes, Polysar *can* give reality to many product ideas, previously impractical with other materials. Why? Because ***there's been a revolution in rubber.** Now . . . with Polysar chemical rubbers and the help of Polymer research chemists . . . you can have a rubber tailor-made to fit the exact requirements of *your* product idea.

Whether rubber now enters into your products or not, you owe it to yourself to investigate what Polysar can do for them. You'll find—as have manufacturers in 40 countries—that Polysar can make a world of difference.

Polymer Corporation Limited, makers of Polysar rubbers, has the largest industrial research and development division in Canada. Why not make full use of these facilities and learn how Polysar can improve present products and create new ones?

Write to our Sales and Technical Service Division, Sarnia, Canada.



Underwater cable, insulated with Polysar Butyl 100, used by pipeline dredge at Steep Rock Iron Range in North-Western Ontario.

Here's How POLYSAR Beat a Critical Insulation Problem

When Northern Electric Company Limited was looking for an insulation rubber—to be used in underwater electric dredge cables subject to extremely rugged treatment—they chose Polysar Butyl 100. This special type of Polysar gives high resistance to ozone, water, heat and cold; provides excellent dielectric properties; has good flexibility; and is readily processed.

If you, too, have a critical rubber problem, Polymer will be glad to help find the solution.

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Reports

News in brief from the world's producers

TORONTO — Extensive manufacturing experience and technology resulting from intensive and varied research activities of N. V. Philips Gloeilampenfabrieken, Holland, have been made available to Canadians through a newly formed company located here.

The **Philips Canadian Industrial Development Company Ltd.,** organized by the parent Philips concern will be an avenue from this country to the processes and manufacturing techniques that are being researched at the European headquarters of Philips.

President of the new company is Reginald M. Brophy, former Deputy Minister of Defense Production and a present member of the Defense Research Board. He has been associated with Philips interests since 1945, when he joined Rogers Majestic Electronics Ltd.

Now chairman of that company, he is also vice-president of B.N.A. Holdings Ltd. and a director of Canadian Overseas Telecommunication Corp.

When asked exactly how the so-called pipeline will function, President Brophy replied: "We will act as a service organization concerned with encouraging the adoption of many of the parent company's industrial processes and techniques which are not yet used in Canada."

Specialists in patents, marketing and other fields will augment the knowledge of the Philips scientists and production experts.

To get the company program of development started, a product called Ferronite which is used in the construction of high frequence television transformers, will be made available by special arrangements to Canadian manufacturers. Welding rods, manufactured by Philips in exclusive processes, will be another product that may be made in Canada.

The activities of the Philips concern are divided into eleven major scientific areas: Lighting; electronic tubes; industrial components and materials; radio; television and miscellaneous apparatus; telecommunications; X-ray and medical apparatus; industrial equipment; electro-acoustics; pharmaceutical and chemical products; music equipment and plastics.

• • •

BUFFALO, N.Y.—More live demonstrations of welding processes than have ever been held under one roof will be conducted at the joint annual spring meeting of the American Welding Society beginning here at the Hotel Statler May 7, and the Welding Show at the Buffalo Memorial Auditorium.

During 21 sessions, which run until May 11, over 100 engineers will give 65 papers.

A session on nuclear reactor components will be sponsored by the Atomic Energy Commission. The metals engineering division of the ASME will co-sponsor sessions on welding of dissimilar materials, welding of stainless steel, tests of welds, and designing for higher working stresses in pressure vessels.

Advance registration cards and hotel information may be had by writing to the American Welding Society, 33 West 39th St., New York 18, N.Y.

• • •

MONTREAL—"Demands of Canadians to see our raw materials processed to a higher degree within this country will result in a marked expansion of our high-labor content industries," forecast F. G. Ferrabee, founding president of the Machinery and Equipment Manufacturers' Association at its inaugural meeting January 12.

The industrial machinery industry, he explained, is a leading example of this trend:

The new association represents a cross-section of Canadian firms that manufacture industrial machinery for our resource and manufacturing industries. Employing over 25,000 Canadians, these companies supply about one third of the $6,000,000 worth of industrial machinery used in this country annually, according to recent statistics.

"Our industry can supply an appreciably larger share of this market, if we have a healthy economic and fiscal climate in which we can develop," President Ferrabee added.

The association recently made representations to the Gordon Commission which is currently investigating the social and economic future of Canada.

Association President Ferrabee is president of Canadian Ingersoll-Rand Co. Ltd. and is assisted in his new job by Vice-President W. A. Montgomery, who is vice-president of the John Inglis Co. Ltd. Treasurer is H. Crombie, vice-president of Dominion Engineering Works Ltd.

• • •

PHILADELPHIA, PA. — DESIGN ENGINEERING SHOW SPACE AT PREMIUM STOP OVER 150 EXHIBITORS BOOKED IN CONVENTION HALL STOP FOUR-DAY PROGRAM STARTS HERE MONDAY MAY 14 STOP

• • •

MIDLAND, Mich.—Completion of the final unit in a $16,000,000 plant here at the Dow Corning Corp. has been coincidental with a price drop in the company's silicones.

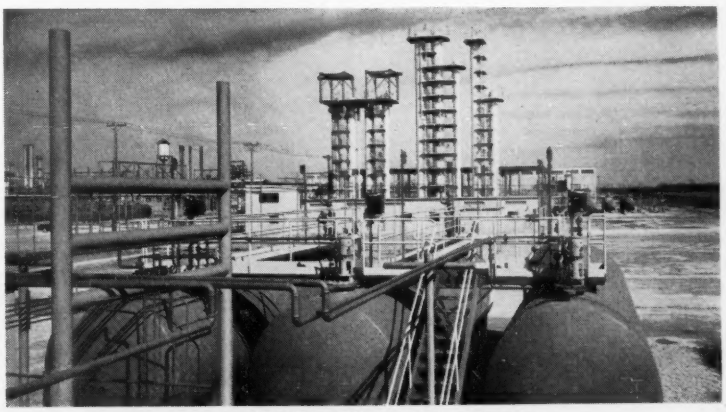
The cut in prices effective January 3 in the U. S. and Canada, explained W. C. Krane, Ontario sales manager for Dow Corning Silicones Ltd., are a direct reflection of the increased use of silicones in the core of product design.

"Uses of silicones range from polish additives and liquid springs to light-load lubricants and mold release agents," he added.

New applications for silicones most recently have been in artificial lungs and in cosmetic preparations.

In surveying the price drops, O. D. Blessing, vice-president and general manager of the Dow Corning Corp. stated: "Our 200 Fluid has always been one of our major products and the new price scale will still diversify further and increase the markets for our many methyl silicone fluids and emulsions.

The industrial usefulness of these fluids, according to Vice-President Blessing, was first evidenced in the rubber industry where they have been used almost exclusively in truck and passenger tires for release agents.



A new unit for Dow Silicones and a price drop

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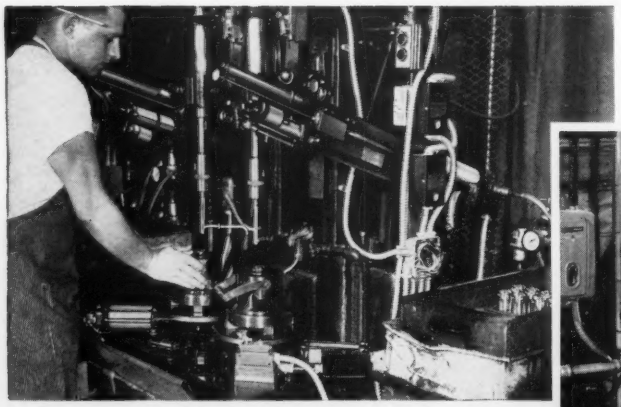
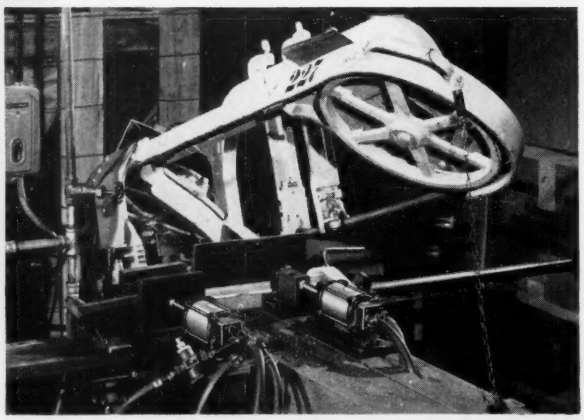
- **Built-in Directional Valve**
- **Built-in Speed Controls**
- **Only a Single Air Connection**



Drill Press Feed powered with Bellows Air Motor makes any standard drill press a fast semi-automatic machine.



Standard cut-off saws quickly converted to automatic operation with two Bellows Air Motors.

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Changing a hand fed machine into a fast semi-automatic or automatic unit right in your own tool room is a cinch with the Bellows Air Motor—the unique air cylinder with all controls built-in.

The Bellows Air Motor is a complete work unit in itself. Directional valve, high or low voltage electric valve operating control, and precision speed controls are all built-in. You require only a single air connection—and that can be made with flexible hose.

Two, three—(or as many as you wish) Bellows Air Motors can be electrically interlocked to work in timed sequence to perform related operations with whatever precision you require.

Bellows Air Motors are ruggedly built, precision-machined, to give years of trouble-free service. Records of twenty—thirty, even fifty million cycles are quite common. And Bellows nation-wide service (more than 100 field engineers in industrial areas of the United States and Canada) assures you of quick competent help in the application of Bellows Air Motors to your specific problems.

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The story of Bellows Controlled-Air-Power and how industry everywhere uses it to find lower-cost ways of doing jobs better. Address Dept. DE 356 The Bellows Co., Akron 9, Ohio. In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto.

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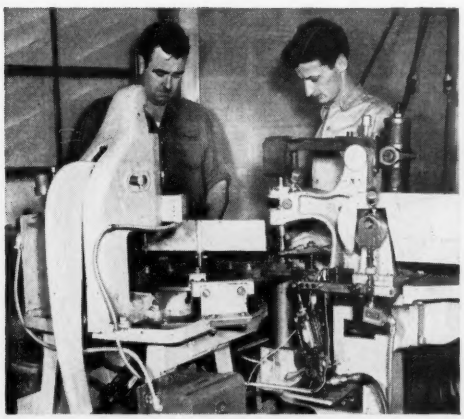
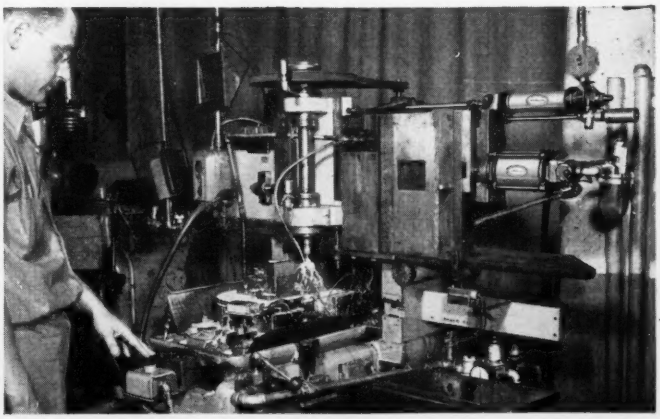


Kick press powered with Bellows Air Motor equals output of 5 foot-powered presses.



Three Bellows Air Motors turned this obsolete milling machine into a high producing unit.

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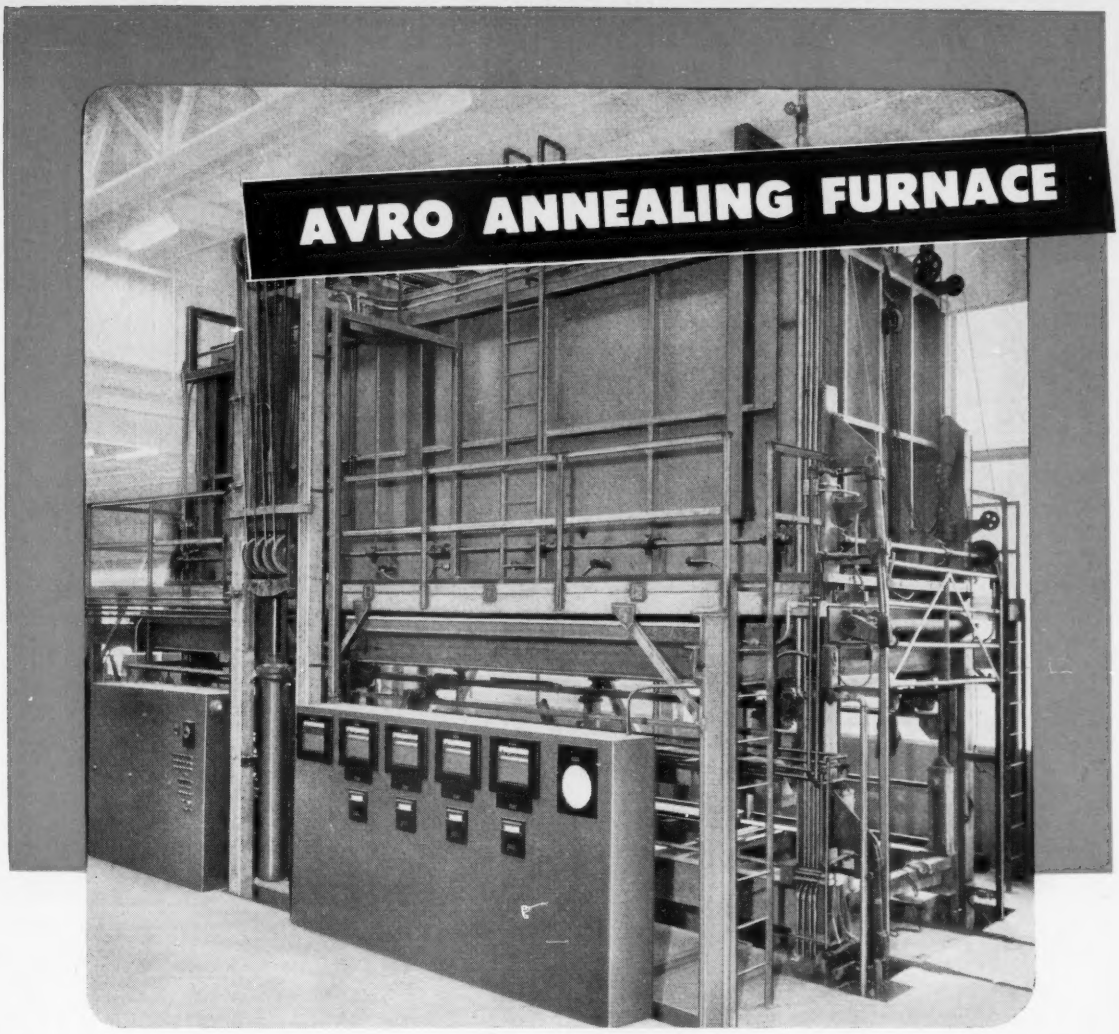

This elevated furnace ages, anneals, homogenizes and solution heat treats aluminum and titanium. The work rack is supported in the furnace chamber by an hydraulic elevator which allows the 5½-ton load to be water quenched within 10 seconds.

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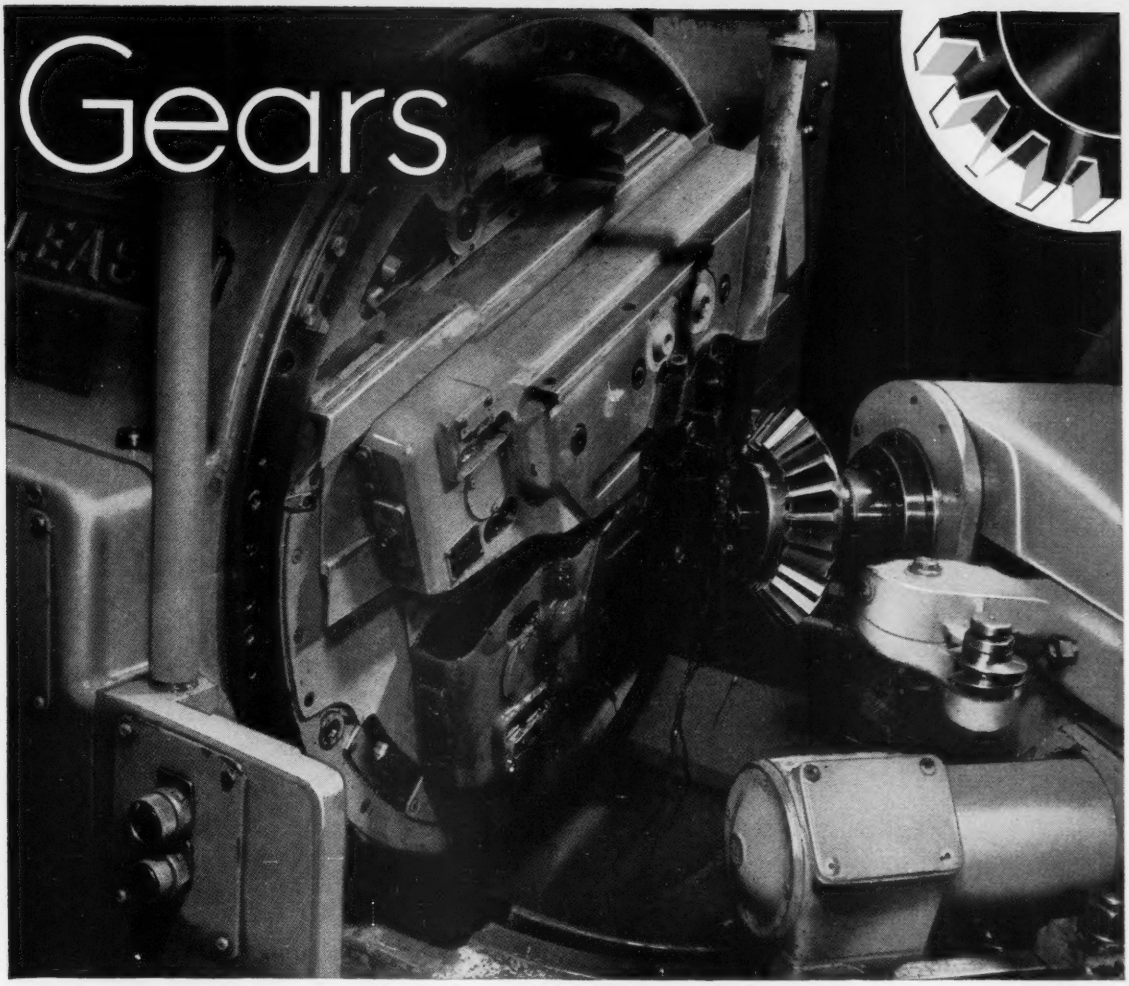
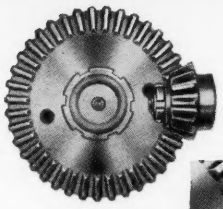
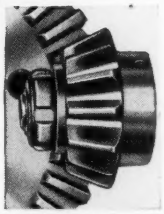
Gears







In patented CONIFLEX design—the tooth is crowned from end to end—usually by one to two thousandths of an inch. The above illustration shows the localized tooth bearing which results from this crowning, allowing wider operating tolerance, smoother operation and easier assembly.

CONIFLEX, the patented Gleason bevel gear with localized tooth bearing, can be made to your specifications at Hamilton Gear. CONIFLEX permits adjustment in assembly and displacement under operating loads—without dangerous load concentration on the ends of the teeth. In addition, the unique CONIFLEX design assures proper distribution of the load over the tooth surface. CONIFLEX bevel gears are available at Hamilton Gear up to 3 D.P. and 3½" face from ratios of 1-to-1 mitres to 10-to-1. Mitre gears can be made to 17 inches diameter, increasing to 24-inch diameter for the 10-to-1 ratio. For further information on CONIFLEX gears, write or phone Hamilton Gear, suppliers of gears to Canadian industry since 1911.

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Flexible Couplings

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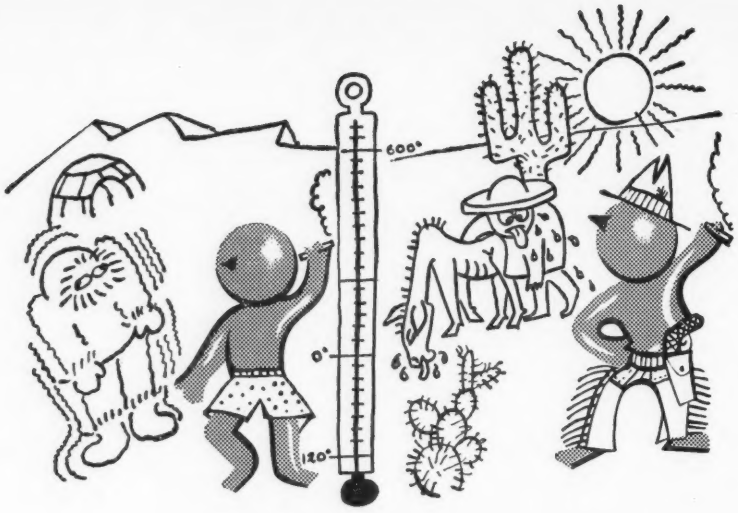

G-E Silicones revel in temperature extremes . . .

At both ends of the thermometer—from 120° below zero to blistering 600°F—G-E Silicones seem to revel in temperature extremes. Industrial and product designers find that Silicones shrug off the ravages of heat and cold that once limited the usefulness of many products and manufacturing processes. Perhaps one of these compounds will help improve your products.

For instance, G-E Silicone Rubbers stand up to 600°F. They will not crack, decompose or become sticky when used as seals and gaskets in jet and diesel engines, electrical appliances and similar "hot" equipment. As bomb-bay door stripping on high altitude planes they are still flexible at 120° below zero.

G-E Silicone Oils and Hydraulic Fluids change very little in viscosity over a wide temperature range. Most petroleum oils will not operate at 50° below zero, while Silicone oils pour freely at 120° below.

In paints and electrical varnishes, G-E Silicone Resins will not flake, discoior or decompose at extremely high temperatures. On exhaust stacks, appliances, furnaces and heaters, colored finishes stand up to 600°F, aluminum finishes up to 1000°F.

There are many G-E Silicone compounds, each formulated for a wide variety of properties and characteristics. You owe it to your business to explore their possible usefulness in your production and for your products.

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Chemical Department Products include

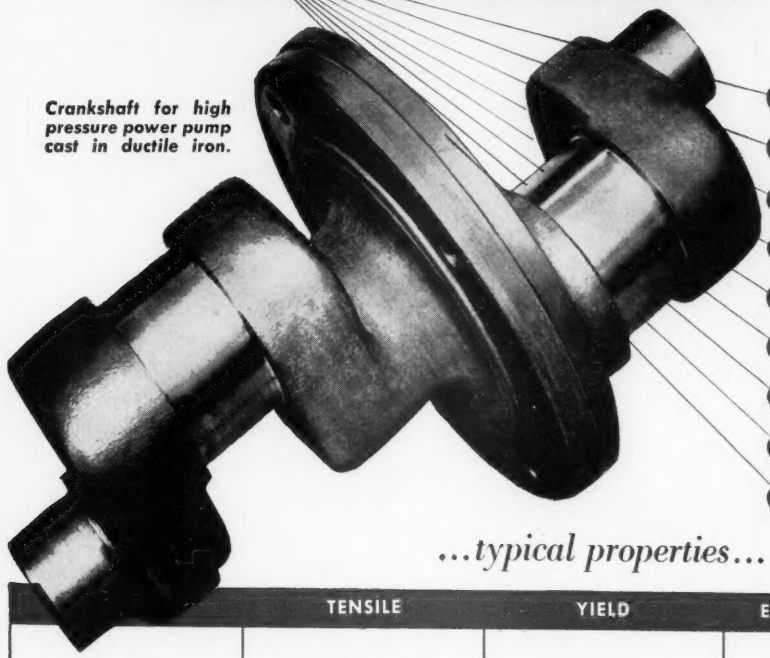
MOLDED AND EXTRUDED PLASTICS • GLYPTAL AND POLYESTER RESINS • CARBOLOY TOOLS • SILICONES • ALNICO MAGNETS

CANADIAN GENERAL ELECTRIC COMPANY LIMITED

NODULOY

... the ductile iron ... is being adopted by more and more industrial groups for applications such as:

- PRINTING ROLLS
- GEARS AND WORM GEARS
- CAST-TO-SHAPE DIES
- CRANKSHAFTS
- FLYWHEELS
- HYDRAULIC RAMS
- MACHINE TOOL CASTINGS
- FARM IMPLEMENT CASTINGS
- RAILROAD EQUIPMENT



Crankshaft for high pressure power pump cast in ductile iron.

...typical properties...

	TENSILE	YIELD	ELONGATION	BRINELL
AS CAST	80,000 p.s.i. to 100,000 p.s.i.	60,000 p.s.i. to 75,000 p.s.i.	1-3%	225-300
ANNEALED	60,000 p.s.i. to 75,000 p.s.i.	45,000 p.s.i. to 60,000 p.s.i.	10-20%	140-180
HEAT TREATED	80,000 p.s.i. to 160,000 p.s.i.	65,000 p.s.i. to 150,000 p.s.i.	1-15%	160-340

...and when to specify it...

1. As a replacement for conventional cast iron, where greater strength or resistance to impact is needed.
2. In redesigning, where higher strength results in less weight — hence lower cost.
3. In place of large malleable iron castings which can be difficult and costly to produce.
4. To replace many steel castings, where higher yield strength and better machinability are important.
5. Where heat resistance is a factor, because of Noduloy's resistance to growth.
6. For "wear resistance" applications which may involve chilling, induction or flame hardening of wearing surfaces.

If you have an application for NODULOY or wish to have more information on the subject, write to:

Canada Iron
foundries, limited
Foundry and Machine Division

921 SUN LIFE BLDG., MONTREAL — 171 EASTERN AVE., TORONTO

Polythene offers industry **ALL** these properties combined in **ONE** versatile material

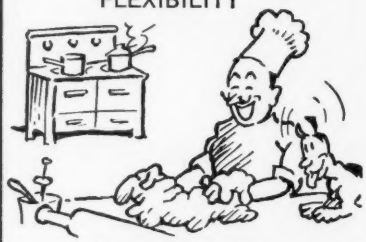
TOUGHNESS

LIGHTNESS

FLEXIBILITY

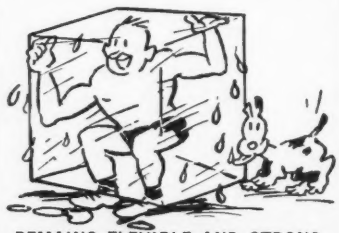
CORROSION RESISTANCE

EXCELLENT ELECTRICAL INSULATION



EASILY MOULDED, EXTRUDED, HEAT SEALED

WATERPROOF



REMAINS FLEXIBLE AND STRONG EVEN AT SUB-ZERO TEMPERATURES

NON-TOXIC

– used for these products and many others!

gland packing rings

wire and cable coating

shoe parts

cold water pipe

spring liners

battery components

chemical and drug bottles

marker rope, heaving lines

bottle caps and closures

C-I-L polythene

PLASTICS DIVISION - SUPPLIERS OF PLASTIC RAW MATERIALS

SIGNAL GENERATOR MS 25
NOISE GENERATOR TYPE DSG 1
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BEAT FREQUENCY OSCILLATOR HO 12
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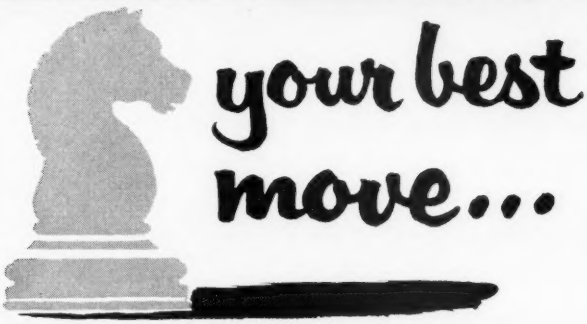
AM STANDARD SIGNAL GENERATOR TYPE MS 15
DISTORTION METER BKF 5
CAPACITANCE BRIDGE TYPE CMB 1
MEGOHMMETER 1 M 3
DELAY LINE KL 41
OSCILLISCOPE OSG 41
MULTIMETER TYPE MM 1



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Before investing in any instrument, you owe it to yourself to try Radiometer — quality instruments in every sense of the word, at most attractive prices.

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Cathode-Ray Oscilloscopes – FM and AM Standard-Signal Generators – Grid Dip Oscillators – Audio Oscillators – Frequency Response Recorders – Wave Analyzers – Distortion Meters – Vacuum Tube Voltmeters – Impedance Bridges – Capacitance Bridges – Q Meters – Megohmmeters – Galvanometers.

Write for catalogues and other literature.

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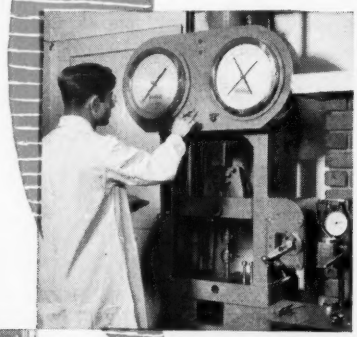
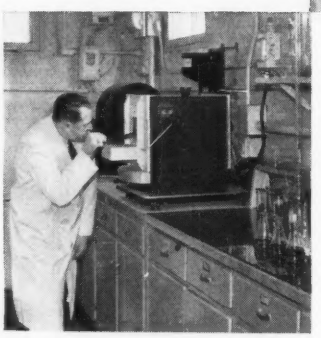
SHAWINIGAN

STAINLESS STEEL

From the balanced blending of metals to the close and careful inspection of the finished casting, 'Shawinigan' laboratory control produces the finest stainless steel in Canada.

This 'Shawinigan' *full control* is your proof of quality . . . your guarantee that 'Shawinigan' Stainless Steel corrosion and heat resistant castings meet every rigid specification for uniformity, longer life and carefree service.





For a quarter of a century, 'Shawinigan' has pioneered the production of superior Stainless Steel for your particular requirements. Investigate the possibility of saving money in your business with 'Shawinigan' Stainless Steel corrosion and heat resistant castings.

SHAWINIGAN

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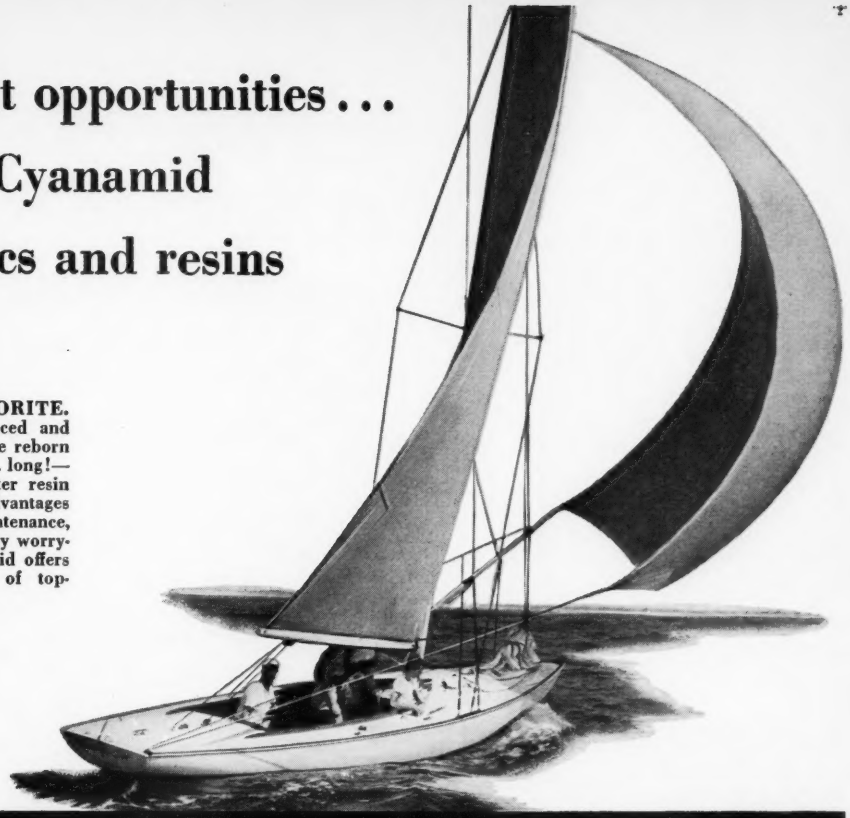
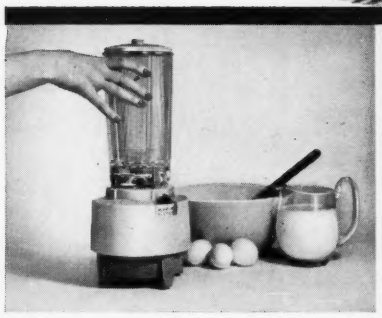
Stainless Steel and Alloys Division

Head Office: Shawinigan Building, Montreal, Que. — Plant: Shawinigan Falls, Que.

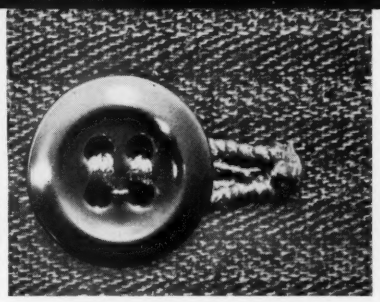
New profit opportunities... created by Cyanamid plastics and resins



NEW LIFE FOR OLD FAVORITE. Atlantic Class sloops, much raced and much favored since the 1920's, are reborn in plastic. The new hull—30½ ft. long!—is molded of LAMINAC® polyester resin reinforced with fibrous glass. Advantages—extra strength, almost no maintenance, longer life expectancy, completely worry-free sailing. Remember: Cyanamid offers the largest available "family" of top-quality polyester resins.



SOLVES HOUSING PROBLEM! To house the Waring Blendor, BEETLE® urea plastic was chosen. BEETLE resists fruit and vegetable acids, staining, chipping. It's unaffected by motor heat. It offers an unlimited choice of *permanent* colors. For better housing conditions, a smart move is to BEETLE.



BEST BET IN BUTTONS—Molded melamine buttons! They *stay* buttons, even under severe laundering, ironing, dry-cleaning. Tough, lustrous beauty in any color makes them ideal for work *and* dress clothing. For a hard and handsome material that defies abuse—choose Cyanamid's Melamine Molding Compound.

WORRY-FREE FURNITURE for office, home, hotel and restaurant is surfaced with melamine resin laminates. Top designers, like Paul McCobb, specify melamine laminates because they resist scratching and marring, reduce the frequency of resurfacing and replacement. Buying or manufacturing furniture? Specify melamine decorative laminates.

Plastics may fit into *your* plans for product improvement... for *profit* improvement. You may be able to get a head start on tomorrow by calling Cyanamid *today*. Tell us your problem. We may well have the answers you need in thermosetting plastics (melamines, ureas, polyesters)... synthetic adhesives... resins for surface coatings.

For technical information—for active cooperation—call

CYANAMID

NORTH AMERICAN CYANAMID LIMITED
PLASTICS AND RESINS DIVISION
160 BLOOR STREET EAST, TORONTO 5, ONTARIO

If your plans call for these features

call for

BAKELITE
TRADE MARK
Polyethylene

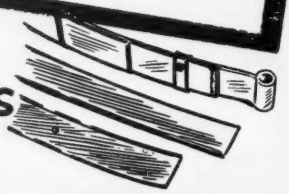
LIGHT WEIGHT

Light weight means economy wherever you use polyethylene, the lightest commercial plastic. One man easily carries a 200-ft. coil of 2-in. polyethylene pipe. Polyethylene carboys cut shipping costs of liquid chemicals. Wire and cable covered with polyethylene can be strung over longer spans, saving poles.

FLEXIBILITY

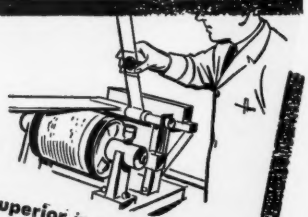
Flexibility is an inherent feature of polyethylene. It needs no plasticizers to make it resilient. The degree of its flexibility depends on its wall thickness. Squeeze bottles made from it recover their shape instantly. This quality means lower breakage costs for articles made from polyethylene.

TOUGHNESS



Toughness is another valuable property of polyethylene. A good example is this auto spring leaf pad of molded polyethylene. It stands up under constant squeezing and acts as a "dry lubricant," preventing metal-to-metal contact. It keeps out sand and grit that could abrade the metal spring leaves.

ABRASION RESISTANCE



Abrasion resistance is superior in comparison with rubber-type compounds. In laboratory test using a revolving drum covered with "Aloxite" 320 metal cloth to provide continuous abrasion, rubber-type compound lost 75 to 80 per cent thickness in only 280 revolutions. Polyethylene lost 40 to 45 per cent in 2000 revolutions.

Polyethylene can be moulded, extruded, formed into film, used to fortify wrapper waxes. It's in plentiful supply. It may be the best way to turn your new product ideas into immediate application. Learn more about it by writing Dept. DE 2,

BAKELITE COMPANY
Division of Union Carbide Canada Limited
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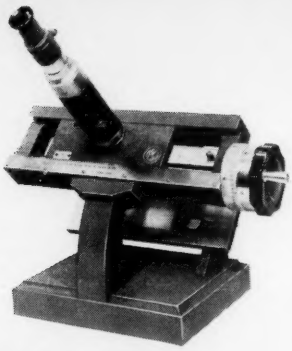
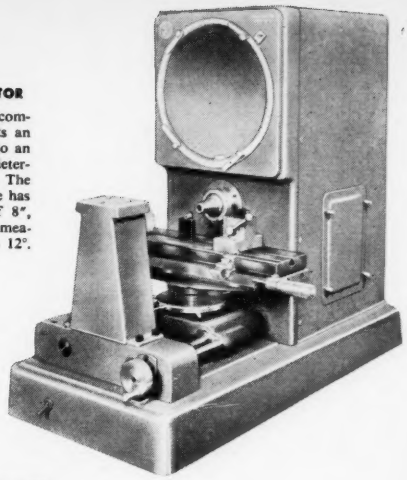
BELLEVILLE — ONTARIO

Sales Headquarters:
40 St. Clair Avenue East, Toronto 7, Telephone WAlnut 4-2119
Sales Office:
1425 Mountain Street, Montreal, Telephone HArbour 3145



MICROMETER SLIDE (Mounted)
A measuring gauge that may be used with a microscope to provide linear measurements—direct readings to .0001". This instrument is also available with a metric scale; vernier reading to .001 mm. The slant stand is equipped with mirror for reflex illumination.

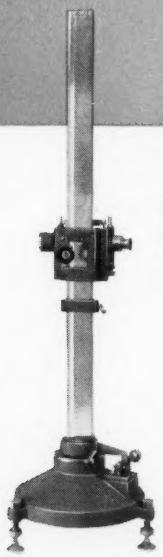
CONTOUR PROJECTOR
A bench type optical comparator which projects an accurate contour on to an 8" screen, to any predetermined magnification. The precision-ground table has a horizontal travel of 8", vertical travel of 2½"; measures helix angles to 12°.

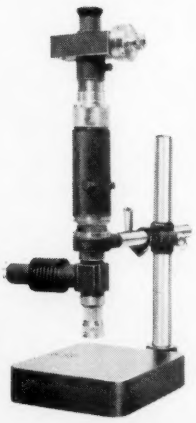


ANOTHER FIRST BY PSC APPLIED RESEARCH LTD.

Precision Measuring Instruments

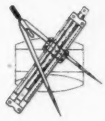
CATHETOMETER
An optical height gauge for vertical measurements, accurately reading to .1 mm. at distances up to 10 ft. The scale is also available graduated in inches. This device has a measuring range of 75 cm.; telescope magnification—15x.





MEASURING MICROSCOPE AND ACCESSORIES
A test base with a measuring microscope. A vertical illuminator may be used when slide illumination is not adequate. The Filar Micrometer eyepiece makes possible measurements of objects to .001".

of Canadian Design and Precision Manufacture



PSC Applied Research Limited, for the first time in Canada, offers extremely accurate, optically assisted, physical measuring instruments of Canadian design and Canadian precision manufacture. Backed by the reputation of one of Canada's most progressive engineering and production companies, these measuring instruments are available now to all fields of industry. Literature and quotations on request. In the Western Provinces, please address enquiries to: Physical Measurements Company Limited, 1438 Erin St., Winnipeg 3, Manitoba.

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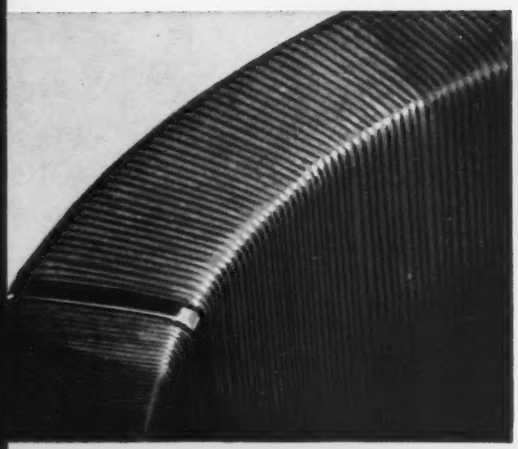
OHMITE® RHEOSTATS HAVE *Smoother Windings!*

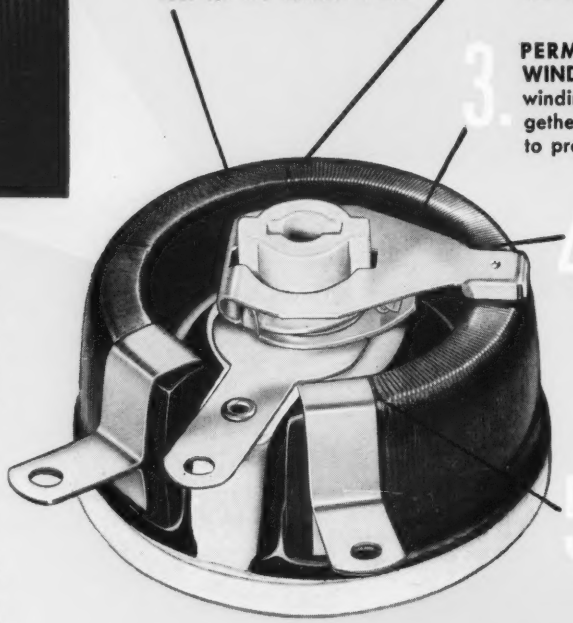


5 REASONS WHY—

1. **PRECISION GROUND CORE** . . . Cores for fine wire, high resistance units are ground to give a smooth, flat contour for the contact brush.

2. **SMOOTH JUNCTIONS** where wire sizes change between sections of tapered windings . . . less differential between wire sizes.

3. **PERMANENTLY LOCKED WINDINGS** . . . Core and windings are bonded together with vitreous enamel to prevent shifting of wire.



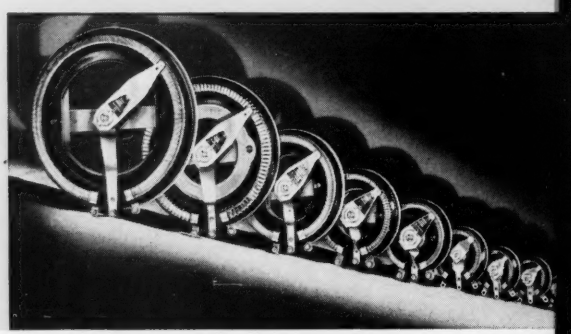
4. **UNIFORM WIRE SPACING** . . . Ohmite has developed special winding machines to insure uniform spacing and eliminate crossover of adjacent turns on fine wire units.

5. **FLUSH TERMINALS** . . . Terminals are flush with windings . . . brush glides smoothly from windings to terminal.

See for yourself! Examine an Ohmite Rheostat first hand. Compare its smoother resistance windings. Turn the knob and note how easily and smoothly the contact brush glides over the rheostat windings.

There's less wear on the resistance wire and on the contact brush. The brush makes contact with all of the turns and the resistance varies smoothly and uniformly as the shaft is turned. Every Ohmite Rheostat is *individually tested* on ultrasensitive electronic instruments to assure perfect contact between the winding and the contact brush.

Standardize on Ohmite Rheostats for unsurpassed dependability, smoothness of operation, and long life.



A COMPLETE LINE OF RHEOSTATS

from 25 to 1000 watts. Also available to meet MIL-R-22A requirements in *each* of the 26 type designations.

Write on company letterhead for Catalog and Engineering Manual No. 40.

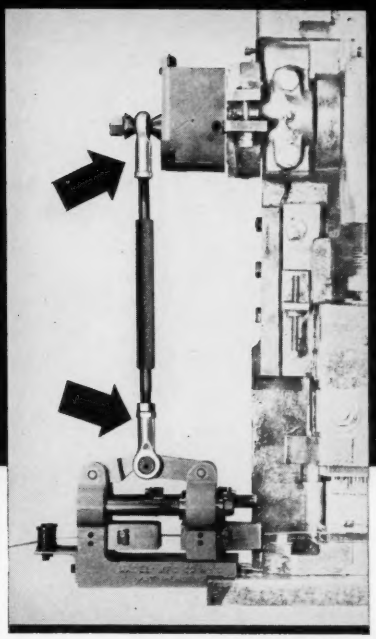
Be Right with OHMITE®

OHMITE MANUFACTURING COMPANY, 3688 Howard Street, Skokie, Illinois (Suburb of Chicago)

RHEOSTATS • RESISTORS • RELAYS • TAP SWITCHES

"at the point of Stress"

HEIM *Unibal* ROD ENDS are used on the Micro-Slide feed for punch presses and eyelet machines.



Micro-Slide is described by Nadel Mfg. Co. as a most accurate power press feed. It will pull heavy reels accurately and has a capacity of .040 – .160 thickness, 2″ wide, 1½″ feed. Heim Rod Ends are used at the point of stress and are found equal to the task.

HEIM ROD ENDS

for dependable, trouble-free performance

They reduce friction and lost motion in mechanical linkages; they correct misalignment of shaft or stud in every direction; their ease of assembly contributes to lower costs; and they carry heavier loads.

Cutaway view of assembled rod end showing lubrication groove between bronze inserts around ball.

Have you reviewed your own plans recently? — with an eye toward economizing? You will find the new Heim catalog useful — or perhaps you would like to have a sample of this revolutionary bearing principle.

Please write.

RBM BEARINGS CANADA LTD.

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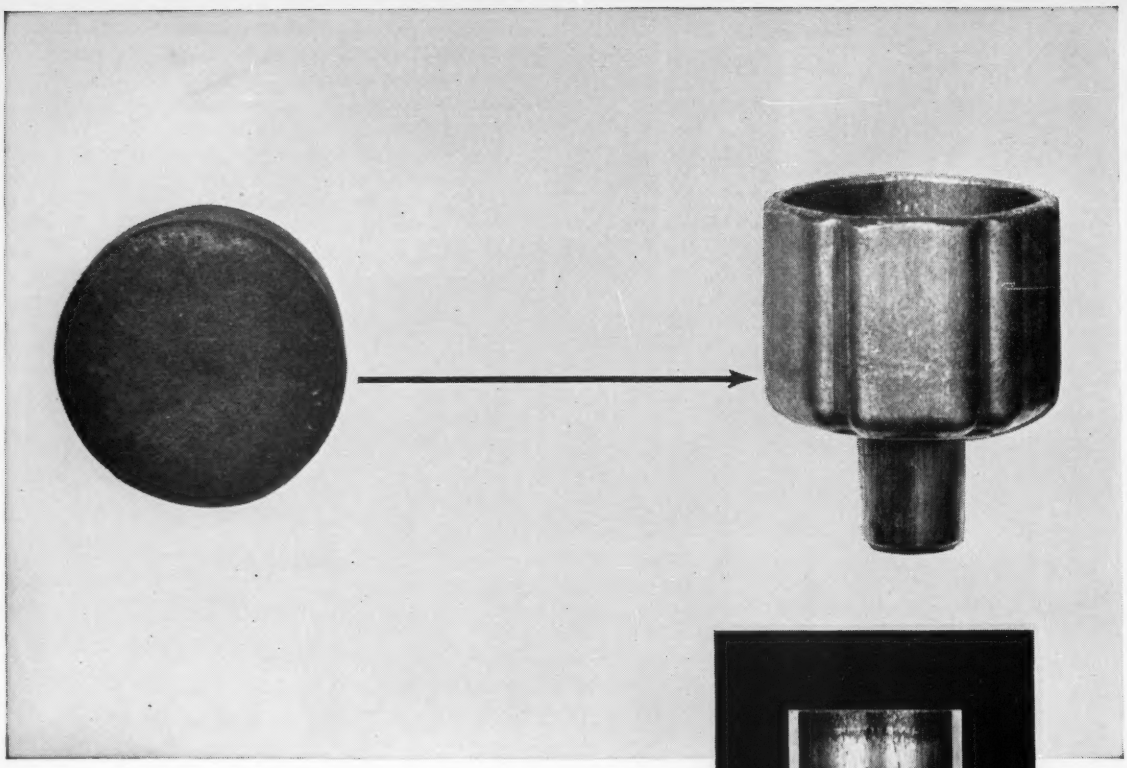

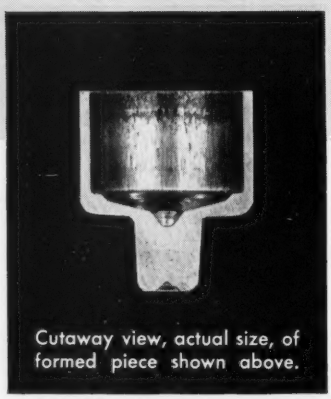

Cutaway view, actual size, of formed piece shown above.

COLD FORMED IN ONE OPERATION

—with Bonderite and Bonderlube!

An experienced production man looked at this blank and the formed parts and said flatly, "It can't be done!" But *it is being done* — in one operation — on a production basis of thousands of units per day.

The blank is treated with Bonderite, and then with Bonderlube. This combination works with remarkable effectiveness.

These two Parker products effect big savings in other ways besides raising production levels. Tool and die breakage declines sharply, fewer process anneals are necessary, operation is simplified, scrap is minimized, and machining operations are reduced.

Cold extrusion, with Bonderite and Bonderlube, may hold the key to cost-cutting for you. Write for information!

**Bonderite, Bonderlube, Parco, Parco Lubrite—Reg. U.S. Pat. Off.*

Since 1915— leader in the field

PARKER RUST PROOF COMPANY
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Rexdale Blvd., Rexdale (Toronto), Ontario

BONDERITE	BONDERITE and BONDERLUBE	PARCO COMPOUND	PARCO LUBRITE	TROPICAL
corrosion resistant paint base	aids in cold forming of metals	rust resistant	wear resistant for friction surfaces	heavy duty maintenance paints since 1883

ANNOUNCING A GREASE THAT WON'T MELT!

A no-melting-point grease that eliminates costly specialty products

DARINA

IMAGINE an industrial grease that won't melt. A grease that takes the punishment of operating temperatures ranging as high as 350°F. And at medium and low temperatures, its mechanical stability and pumpability compare with the best soap type greases.

Darina Grease 2 meets these fantastic demands.

Here is a non-soap, inorganic gelled grease that has no melting point. There's absolute safety to working parts in extended wet or dry applications where temperatures range as high as 350°F.

Field tested under the most severe operating conditions, Shell Darina Grease 2 proved superior to more costly special-purpose greases. Important savings were recorded in a wide range of applications. The booklet "Darina Grease 2" tells how your operation can benefit from this new multi-purpose grease. It gives details of field tests together with other technical data you'll want to know about. Write to any Shell Oil Company office for your free booklet.

Other lubricants produced by Shell for industry are:

Alvania Grease
Voluta Oil 23
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SHELL

GREASE 2

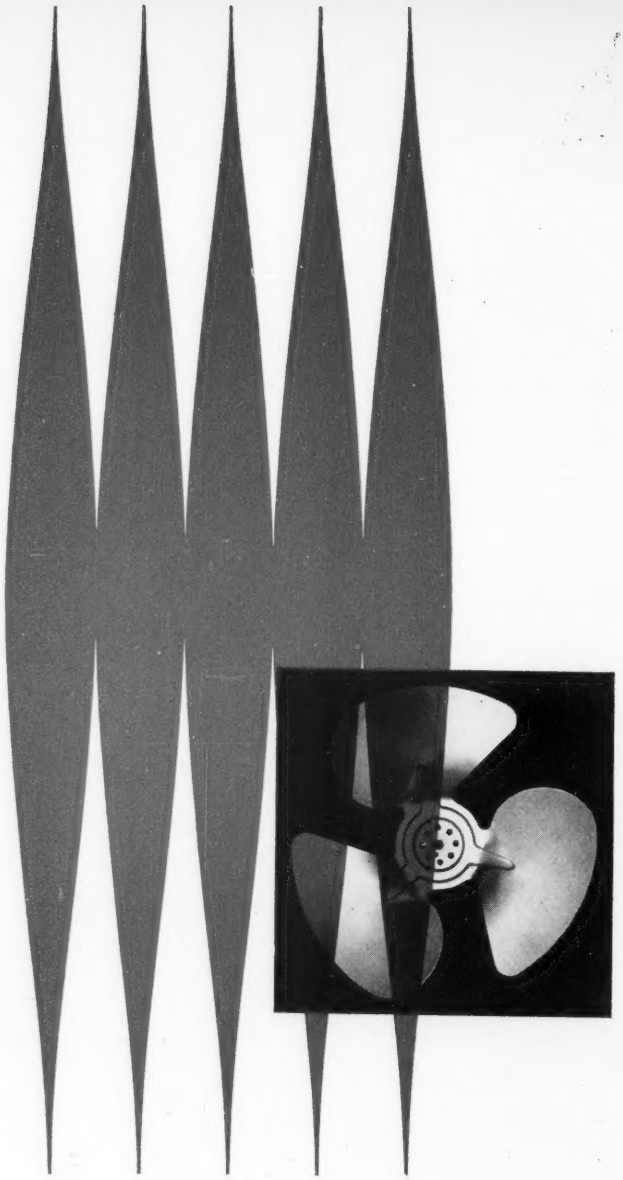
SHELL OIL COMPANY OF CANADA, LIMITED
TORONTO MONTREAL VANCOUVER

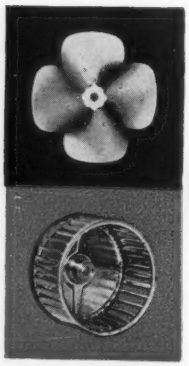
You Get Quiet Operation at Low Cost

...when you use Torrington's Extra-Quiet "LU Series" fan blade

Especially designed to give quiet operation in a wide variety of applications. The simple one-piece construction of the "LU Series" also makes it available at an unusually low price. Manufactured in 7¾"-8¾" and 10" diameters. Pierced for all unit-bearing motors.

The "LU Series" fan blade represents only a small portion of the unusually broad variety of air impellers which Torrington produces for heating, ventilating, refrigerating and air conditioning. This product range and manufacturing capacity can provide . . . quickly and at low cost . . . the fan blade or blower wheel best suited to your air-moving requirements. Torrington has extensive research and test facilities which are available to assist you in the solution of design problems relating to air flow, sound and vibration. No one has had more experience in the design and production of air impellers than Torrington. Nowhere else can your dollars buy so much in terms of product quality and customer service.





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VIP's

Important people who are in the news

THE TORONTO-born and educated chairman of the Hydro-Electric Power Commission of Ontario, **Dr. Richard L. Hearn,** has received the Professional Engineers medal citing him for what is termed, "his accomplishments in the sphere of hydro-electric engineering and for his contribution to the welfare of mankind in furthering the application of nuclear fission in peacetime uses."

In joining the only previous recipients of the coveted medal, Rt. Hon. C. D. Howe, Dr. C. R. Young, Gen. A. G. L. McNaughton and Dr. J. B. Tyrrell, he remarked, "I realize that I have had the privilege and honor of being the captain of a team, comprised of engineers and technicians, skilled and unskilled labor,

DR. R. L. HEARN
—"Captain of a team"

working directly and indirectly for the Ontario Hydro organization."

Without their help, he declared, he could not have made the contribution for which he was awarded the medal.

A director of Atomic Energy of Canada Ltd., Dr. Hearn is heading for the most part the Hydro's two-year program of study of an atomic reactor for generating electric power.

During his acceptance address he plainly approved the Canadian universities program of study for the atomic specialists.

"Our universities are teaching all the fundamentals necessary for the engineer who chooses to go into the nuclear engineering field," he said.

With the untimely death of the late Robert H. Saunders in the January 1955 air crash, sixty-five-year-old Hearn who had been general manager and chief engineer of Hydro became his successor as chairman of the organization.

His road to the top post in the Ontario Hydro, which has its 50th anniversary in June of this year, began in 1913 when he graduated with his BASc. from Toronto. For the next five years he was a design engineer for the infant Hydro, his first project being the Wasdells Falls power plant. Then, from 1918 to 1921 he was supervisor of designing and drafting on the Queenston-Chippawa project.

In Spokane Washington for the following three years as assistant chief engineer of the Washington Water Power Company, engineer Hearn returned to Niagara Falls, Ontario, and became chief engineer and secretary-treasurer of a firm of consulting engineers.

For the next 18 years he worked as a consulting engineer and chief engineer for private companies.

In the mid-war years of 1942 to 1944 Dr. Hearn was named executive assistant to the chairman of Hydro. Subsequently on loan to the Polymer Corporation, he acted as chief engineer, directing and supervising construction of a synthetic rubber plant at Sarnia.

Returning to Hydro he assumed his former status, that of executive assistant, and was put on loan to act as Canadian technical adviser to the Public Utilities Board, Washington DC.

Member of numerous clubs and engineering societies, Dr. Hearn was awarded the honorary degree of Doctor of Engineering from Toronto University in June 1952, the same year that Canada's largest fuel-electric power plant located in Toronto, was given his name.

Dr. Hearn is married and has one daughter. His permanent home is at Queenston, Ontario, overlooking the Niagara River. There in quiet surroundings he spends some of his free time at his hobby of photography.

• • •

A CANADIAN-owned electronic development company, entirely independent of foreign control or association, has been formed by a group of young Canadian engineers and scientists who have been seeking an outlet in this country for creative talents in the electronics field.

President of the new organization located in Montreal and Toronto and known as Pylon Electronic Development Co. Ltd., is **Stanley E. A. Pinnell,** described by an associate as "a farm boy at heart whose faith in the Canadian future is as rugged as the daily trek he made to school—seven miles barefoot in his native Alberta."

Asserting his faith in the company, president Pinnell commented, "Although we are a small operation, we have mustered a good deal of technical experience and training in the field of original design."

An honor graduate of Manitoba University's faculty of applied science in 1945, President Pinnell got his Master's degree in science at Alberta U. in 1947. Trained as a mathematical physicist, he

STANLEY PINNELL
—"Seven miles barefoot."

then went to the University of Minnesota and the Massachussets Institute of Technology for study of mathematical techniques of communication.

Co-inventor of the tin-hat antenna and the microwave wedge, researcher Pinnell also holds several patents in the radar scanners and systems field.

Widely experienced in VHF propagation, scientist Pinnell was associated with the research group at the RCA Victor Co. Ltd. for six years.

• • •

THE INVENTOR of the Enjar Wheel (see Design Engineering November 1955) is dead at 68.

James Matthew MacLean, president of the Enjar Wheel Co., died in Windsor February 1, after a two-month illness. He formed the company of which he was senior executive after many years of research into resilient wheels that began in 1918.

Born in Valley Field, Prince Edward Island, Mr. MacLean resided in Vancouver, B.C. and Detroit, Mich. before he came to Windsor in 1947.

Climax to his 13 years of intensive study since retirement came last summer when he produced the working model of the Enjar motor and railroad wheel.

Noranda HIGH I.Q. Aluminum Silicon Bronze Rod

It machines 50% to 70% as fast as free-cutting brass . . . is 9% lighter, 50% stronger than half-hard Naval brass, has excellent corrosion resistance and a tensile strength of 85,000 psi when annealed.

You can profit by using Noranda Aluminum Silicon Bronze Rod for high-strength screw machine parts, marine and pole line hardware, valve stems and pump parts, nuts and bolts. Free machining means faster production, longer tool life. High strength means superior wear, top performance.

We'd like to put these advantages to work for you. Our representative will be glad to show you how the *High Inner Quality* of Noranda Aluminum Silicon Bronze and other Noranda Alloys can help you to product improvement.

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Design Engineering

How near is the gas turbine car?

By P. E. BIGGAR

Six years ago, Britain put the world's first gas turbine car on trial. Engineers have come a long way with the idea since then

IF YOU HAVE flown in a Vickers "Viscount" you must have been favorably impressed by the smoothness and quiet running of the gas turbines that drive its propellers. Would this engine be equally attractive for automobiles?

It seems very probable. The drawing (facing page) shows the essential parts of a typical automotive turbine. You will see that it is exceedingly simple, with only two moving parts; there is a shaft in the left-hand (or gas generator section) with a compressor rotor on one end and a turbine on the other. Then there is another shaft in the righthand (or power section) which takes the power of a second, separate turbine through a reduction gear to drive the car.

The function of the gas generator section is to supply hot, high-velocity gases to the power section. To do this, it draws in air through the intake screen and silencer at the left. This air is compressed to about 45 psi in the centrifugal compressor, which runs, at full load, at about 40,000 rpm. In a turbine of the size we have in mind, the compressor rotor will have a diameter of about 11 in., so that the tip speed of its blades is about 1,200 mph.

The compressed air is then slowed down and conducted to the burner. One burner is ample for several hundred horsepower; two are used where space is restricted. In the diagram, for simplicity, we have shown a direct flow of the air from the compressor to the burner. The fact is, however, that, if we are to obtain anything like a satisfactory fuel economy, we shall have to introduce a heat exchanger.

The purpose of the heat exchanger is to preheat the air on its way to the burner, making use of heat that would otherwise be wasted in the exhaust gases. Now it is obvious to any good layout designer that it is not going to be at all easy to work in a heat exchanger at this point; but it has to be done, since an efficient heat exchanger will make all the difference between a fuel consumption

Continued over page

The car of tomorrow, GM's Firebird II, is on the road today. But it is not yet nearing production.

Gas turbine car *(Continued)*

that competes with that of a gasoline engine and one four times as great.

In the burner, the air is heated to about 1,450°F (perhaps 1,600°F momentarily during acceleration) by the flame of fuel which is sprayed in continually from the fuel nozzle. The fuel is ignited in the first place by an electric spark. In fact, the whole burner is not unlike the combustion chamber of an oil-fired furnace. Only about one quarter of the air is used for combustion, the over-all air-fuel ratio being kept high so as to hold down the maximum temperature. For this reason, and to prevent the flame from being blown out, the combustion chamber is carefully shielded. The design of a satisfactory burner is quite difficult and involves a good deal of cut-and-try engineering. This is especially true if heavier fuels, such as diesel oil or furnace oil, are to be used. In this case it is difficult to avoid carbon which, having built up in the burner, breaks loose to ruin the blades of the turbine.

From the burner, the gases, now at a bright red heat, flow to the first turbine. This is almost always of the single-stage type—meaning that it has just one set of fixed and one set of moving blades. The hot gases give up about two thirds of their total energy in this turbine—in other words, it takes about 400 hp to drive the compressor.

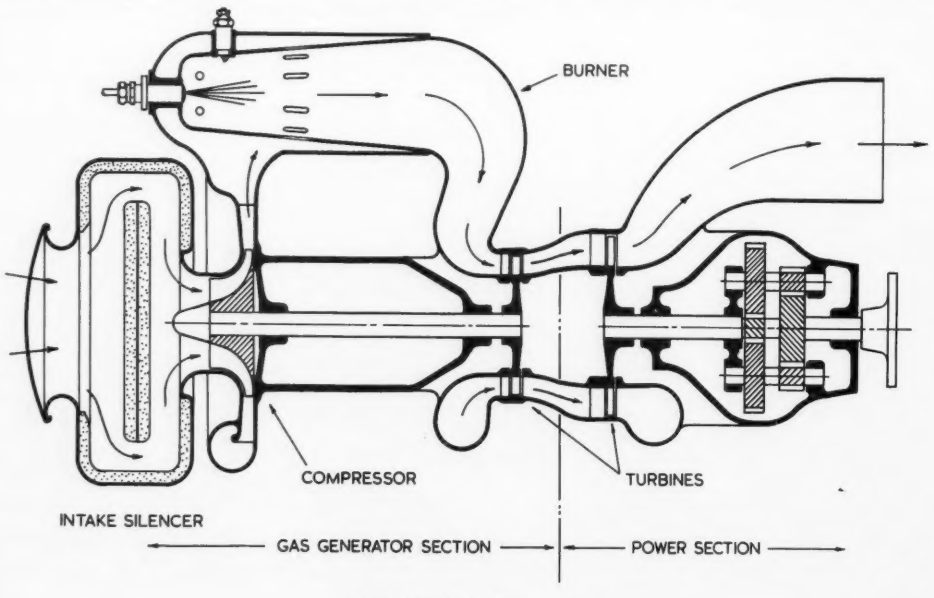
It is the maximum temperature at which these turbine blades will work satisfactorily that largely limits the maximum efficiency that we can expect from the turbine. Engineers have been at work on this problem for some years, since it applies directly to the blading in jet engines for aircraft. New and better materials are constantly being developed, but the trouble is that, to an automotive engine man, they seem very expensive. Also it is rather frightening to think of a turbine rotor spinning at 40,000 rpm and glowing a brilliant cherry red. We are apt to forget that parts of a high-output gasoline engine run at a cherry red temperature too. The difference is just that we cannot see them.

The remaining energy of the hot gases, still at nearly 1,300°F, is now ready to go to work on the turbine of the power section. This is slightly larger than the generator turbine, perhaps of 11 in. diameter and runs at about 25,000 rpm. This is, of course, far too high a speed for a conventional car transmission and axle, so a reduction gear is used. Its ratio will be about 8 to 1, so as to give an over-all ratio to the road wheels of about 35 to 1.

Now it would be possible to omit the power turbine and to take the drive directly from the generator turbine shaft. It is simpler, however, to have the split-shaft arrangement shown in the diagram. With this arrangement, the generator section can be left idling while the vehicle is standing and the load picked up smoothly by the power turbine, since the two are connected by what is really a built-in fluid coupling, with hot gas as the working fluid.

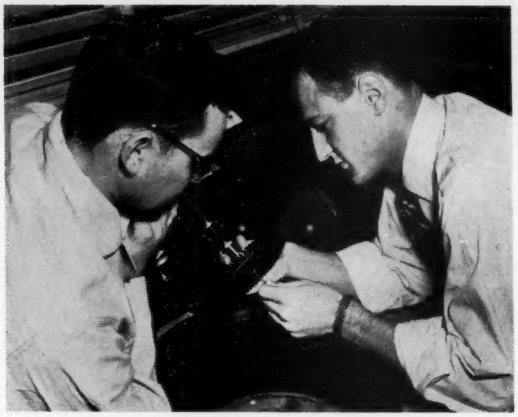
The gases leaving the power turbine are still at a temperature of about 1,100°F. It is therefore well worth while to duct them back through a heat exchanger, as already described. In fact, if they are turned loose through a conventional exhaust pipe, they are going to be objectionably hot. This was brought home to the driver of the General Motors gas turbine bus which has a vertical exhaust stack and, as yet, no heat exchanger. He revved up his turbine under a fire sprinkler head and gave himself an unexpected shower bath.

So much for how the gas turbine works; but how

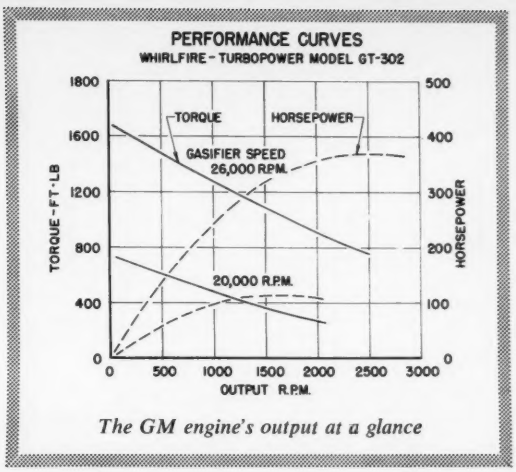


All that it is . . .

The new engine consists of two simple parts. The gas generator (left) and power section (right).



Testing the fast-spinning turbine wheel. To make sure it is safe, it will be seriously overstressed on test.

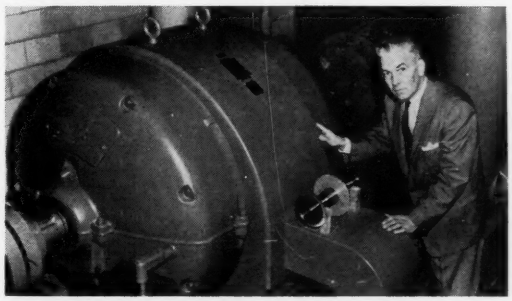


The GM engine's output at a glance

attractive is it going to be in an automobile? The question can be answered quite fully since there are already several turbine driven cars on the roads. The first of these, a British Rover, began its experimental runs back in 1950. This car has covered many thousands of miles of motoring and has been driven at immense speeds—up to 152 mph during test runs.

Then about three years behind the Rover came General Motors' Firebird. Unlike the normal looking Rover, this was a very dramatic and strictly experimental car. It taught GM engineers much about turbines in practise and led the way to the new family sedan, Firebird II, shown in our lead picture.

The huge Austin motor company (now British Motors Corporation) also has a gas turbine car on the



Chrysler's tiny compressor (right) can move more air faster than the big all-purpose compressor beside it.

After 9 years work, Chrysler's turbine (here being lowered into a stock Plymouth) may be soonest in production.

road. It was watched in action by 35,000 spectators when it took part a few months ago in the company's silver jubilee celebrations. This car is believed to be running with a newly patented fuel saver which cuts in when the car is idling.

Of all the big automobile makers, the Ford Motor Company has had the least to say about gas turbine experiments. But it too, has engines under test and will doubtless show, in the end, that it is not being left behind. So far, it has released no photographs and has been very shy of comment.

The company which, in North America at least, seems to be furthest ahead with this work is the Chrysler Corporation.

It has produced what looks like a perfectly normal red and white Plymouth which is, in fact, the very advanced "Turbine Special." If we lift the engine cover and have a look at the powerplant, we find that the space is filled to overflowing with unfamiliar machinery —machinery that bears no resemblance whatever to the familiar V-8 engine. For the gas turbine, simple and compact by itself, as our diagram shows, is bulkier than a gasoline engine when surrounded by its heat exchanger, duct work and heat shielding. Fortunately the turbine needs no water cooling, so the intake silencer can be placed in the space formerly occupied by the radiator.

It is lighter than you think

We are told that this turbine is rated at 120 hp and that, in spite of the fact that it is comparatively heavy in design, it weighs, with heat exchanger, about 250 lb. less than the gasoline engine together with the engine's cooling system. Later on, when sheet metal parts can be used in place of castings, it should be possible to reduce the weight of the turbine to between one-third and one-half of that of the gasoline engine, in pounds per horsepower. We will probably be told that the turbine is running on kerosene or jet fuel; turbines will run on a comparatively wide range of fuels. These fuels must be clean-burning; they must not leave carbon deposits in the burner, and of course no anti-knock additive is necessary.

Now let us take a typical gas turbine car on the road, to see how it performs and how it might appeal to you as a car owner. The control pedals and levers (or push-buttons) are exactly as we would find them in a conventional car. There are a few additional instruments—a rev-counter that reads to 50,000 rpm and two temperature indicators that range to 1,600° F. But these are mainly for the benefit of the test engineer and would not appear in a car offered for sale.

You turn the ignition key in the lock and an indiactor light on the dashboard comes on, to show that an electric starting motor is beginning to spin the gas generator section of the turbine up to its idling speed, about 10,000 rpm. When this speed is reached, the fuel is turned on automatically and sprays from the jet in the burner. At the same time, the ignition is turned on momentarily to ignite the fuel, much as in an oil-fired furnace. Once the burner fires, the ignition and starting motor are turned off automatically and the gas generator section of the turbine is idling on its own. The indicator light on the dashboard goes out. All this took about 8 seconds. It has been impossible to tell at what point the turbine fired, or, in fact, that the turbine is running at all, were it not for a faint, high-pitched whine, rather like that of a vacuum cleaner running in another part of the house.

Now let us get the car under way. You either take the hand brake off or move the gear selector from Park to Drive. There is no neutral in this car, since it is not safe to leave the power turbine without any load; it would run away and reach a dangerous speed if the generator turbine were speeded up while the power turbine is in neutral. As soon as we take the brake off, or put the transmission in Drive, the car starts to creep forward, just as does any car fitted with a hydraulic clutch. You put your foot down on the accelerator and, surprisingly, nothing much seems to happen for a moment. It takes the generator turbine about 5 to 7 seconds to accelerate from idling to full speed, about 40,000 rpm, to supply the power turbine with a sufficient flow of gas for maximum torque. But acceleration soon increases and the car seems to rush forward without effort, as though it were being towed.

Development engineers are still undecided on the question of whether a turbine-driven car requires any change-speed transmission. From the torque curve, it seems that a two-speed, self-changing transmission is well worth while in terms of performance. Its cost would not be great, as the car has to have a reverse gear in any case.

Now the time has come to stop the car. You take your foot off the accelerator and notice at once that the car is not slowing down as usual. The friction of the power turbine is very small, so small that it seems as though the car were coasting in neutral. So the brakes will have more work to do and will require better cooling. In the conventional car, a vacuum is readily available for vacuum-servo brakes, but, with a gas turbine we have no vacuum. No doubt power can be obtained from a turbine-driven hydraulic pump, much like the pump that now energizes power steering.

The gas turbine is light in weight and can be built for a third to a half as many lb. per hp. as a gasoline engine. This makes it possible to install the turbine at the rear of a car, if desired. It is air-cooled and so has no freezing problem. It has its own torque converter and it will run on fuels that are slightly cheaper than gasoline.

But against the gas turbine is its exceedingly high cost. It is not possible to say what turbines will cost on a production basis, but let us guess $5 a horsepower, compared with about $2 a horsepower for a gasoline engine. The turbine must be accurately made and requires a fair amount of $5-a-pound heat-resisting materials. Also, to compete with the gasoline engine in fuel economy it must have a heat exchanger.

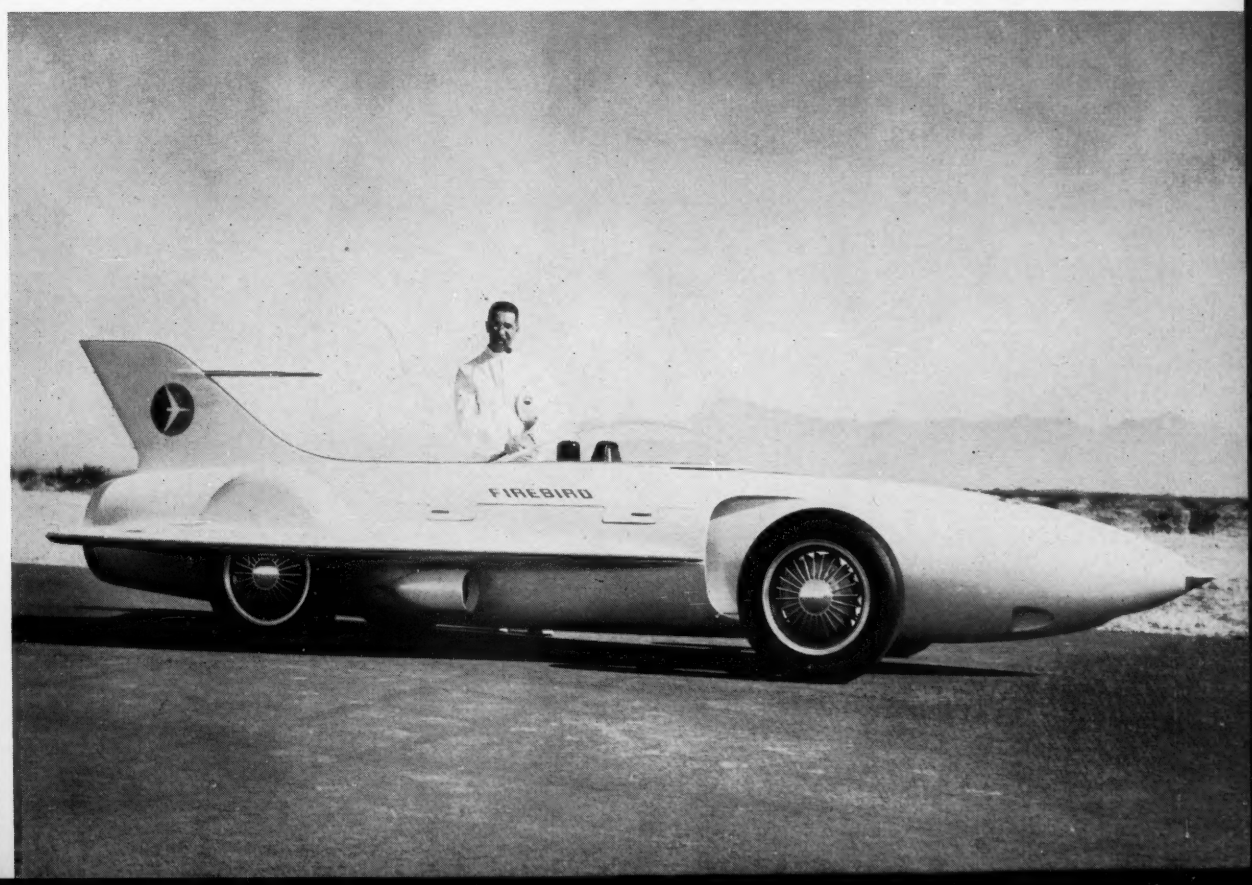
Automotive engineers have two types of heat exchanger under development. The first is the conduction type, rather like a water-tube boiler, but with the air to be heated in the tubes, difficult to design sufficiently light and compact, easy to clean, without high pressure losses. The second is the capacity type, in which a rotating disc of porous metal is used. One sector, almost half, of the disc soaks up heat from the exhaust gases that flow through it. Then the disc, revolving, carries this heat over to the opposite sector, through which the air from the compressor is flowing.

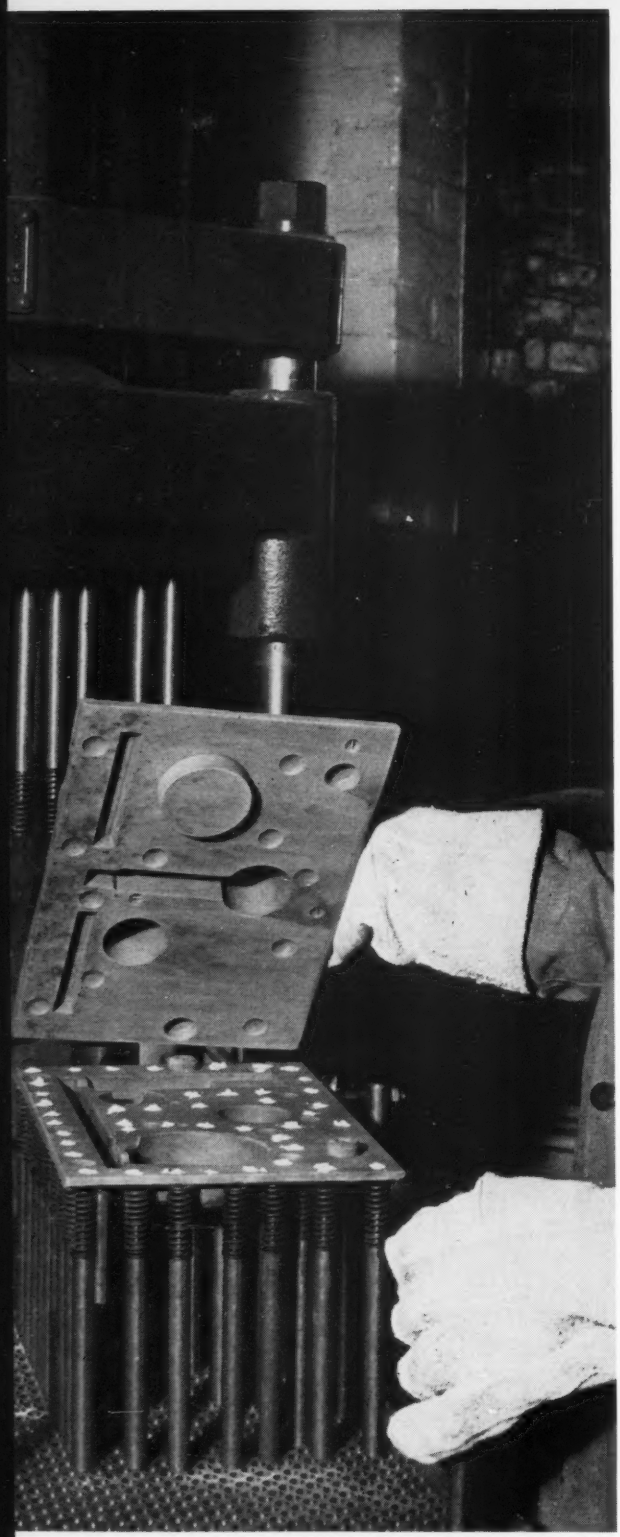
So to the question of how much it will eventually cost to build a reliable **(Continued on page 72)**

First of them all, this Rover was test driven at 152 mph four years ago. It is not yet ready for production.

The Rover convertible (above) and Firebird special (below) began it all

First North American gas turbine car was GM's dramatic looking Firebird I developed experimentally during 1953.





Strongly bonded shell mold results from dry phenolic resin on hot drag half of mold, hot cope positioning and spring pressure. Residual heat effects resin cure.

Methods

Shell molding process

By J. E. BOLT

Consumption of molding resins rises threefold, number of foundries are doubled in rapid two-year increase

IN THE FEW years since its introduction shell molding, a production method, has grown vigorously. Indications are that the number of foundries producing shell mold castings in Canada and the U. S. has doubled in the last two years and in this period consumption of shell molding resin has increased about threefold. During the last five years, it has increased by 16 times.

The nature of shell molding is radically different from the conventional use of green sand.

The molding materials in shell molding consist of a relatively fine-grain, dry, silica sand mixed or coated with a two-stage phenol-formaldehyde resin. This mixture falls onto a heated metal pattern normally at 400 to 500 F. Heat softens the resin in the mix adjacent to the pattern. The mix becomes plastic, conforming to the pattern contours. After a predetermined time, usually 10 to 20 seconds, the relative positions of the mix and pattern are inverted, so that the unheated part of the mix falls away from the pattern, leaving a soft uncured "shell" approximately ¼ in. thick which adheres to the pattern. This is done by using a pivoted dumpbox onto which the pattern is clamped and into which the dry mix is placed. Then the pattern is righted and placed in a curing oven for approximately 60 seconds. The cured shell is then ejected from the pattern and the mating halves are either bonded ready for metal pouring or set aside for future assembly and pouring.

Normally, 350 or more assembled molds, approximately 15 in. by 20 in. are a good day's average for a single machine. Each of these molds may contain from one to thirty or more casting cavities, depending on size. Once the proper gating and risering have been worked out and incorporated in a heat-resistant metal pattern, the process lends itself to high production.

For the foundryman, shell molding offers a versatile, high-production process in a clean shop, where practically any metal can be poured into smooth, dimensionally stable moisture-free shell molds. This gives greater fluidity, higher yield, less poured weight per casting, and results in castings with a smooth, attractive surface finish, a stronger and denser internal structure and close dimensional tolerances.

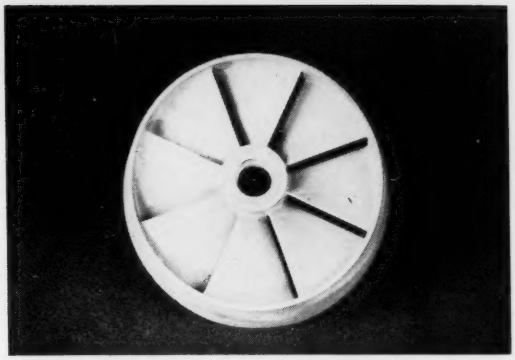
But castings offer direct advantages to the end user which accounts for the phenomenal growth of shell

eliminates machining

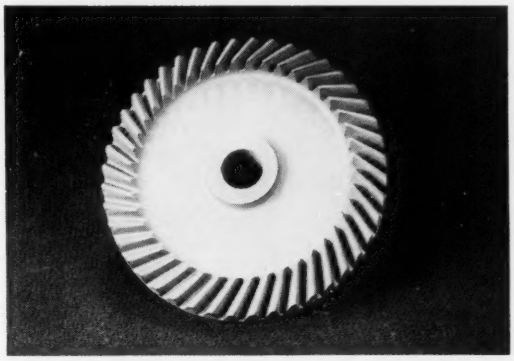
molding. Shell molds are so stable that castings can be made very close to the finished size, reducing poured weight and eliminating machining stock.

Because of the improved surface quality and close dimensional accuracy possible, in many cases machining may be either completely eliminated or greatly reduced. One of the photos shows textile machinery as cast and another picture shows gear teeth as cast. For many low-speed low-stress applications, such gears are usable after over-finishing the bore. Even on close work, only a finish cut would be needed on the gear teeth. Another picture shows a combination of shell molded gear teeth with a pulley groove formed by a dry sand cone.

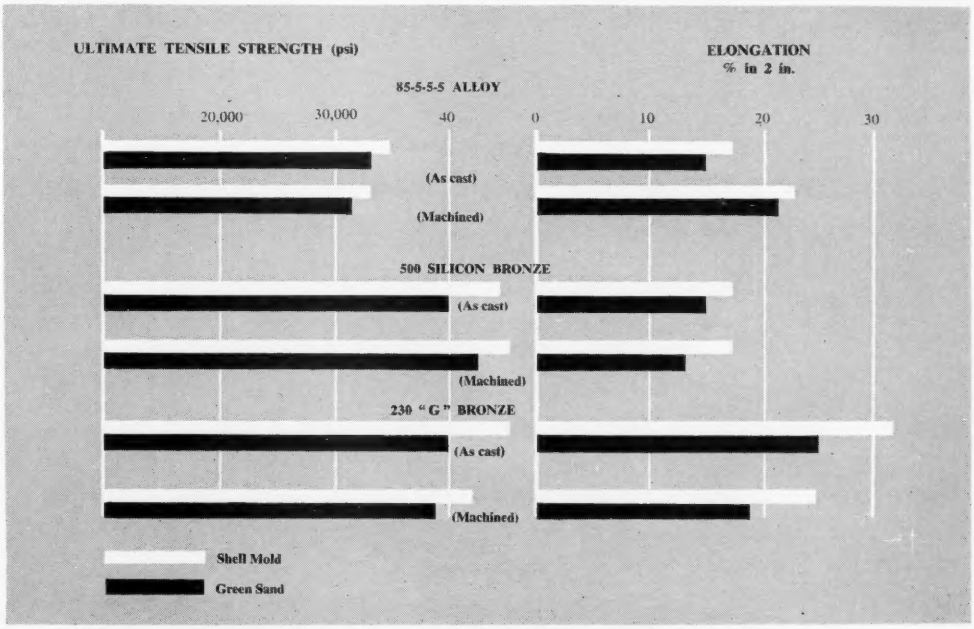
Metallurgical considerations of shell mold castings verify the stronger, sounder, internal structures produced. Compared with green sand molds, the shell molds are moisture-free and relatively insulating. This condition retards metal solidification, allowing the inclusions and entrapped or dissolved gases to be scattered, leaving the internal structure of the casting extremely



Aluminum impeller with excellent reproduction of the surface detail was produced by shell molding process.



Above, gear teeth as cast, for many low-speed, low-stress jobs, usable after over-finishing the bore.



Comparison of physical properties shell mold vs green sand

Note high tensile strength, elongation values for shell mold in machined, as cast conditions.

sound. A step bar was purposely poured without a riser to determine where shrinkage would occur. There are two areas of concentrated shrinkage. Dispersed shrinkage is not nearly so probable as in green sand castings.

A comparison of the physical properties of shell mold vs. green sand castings in three alloys is shown in an accompanying picture. Both ultimate tensile and elongation values are greater for shell mold castings in both as-cast and machined conditions. This factor is important not only from the strength viewpoint, but can account for a considerable saving in machining time. Sound metal means a reduction in the number of rejects caused by internal defects discovered after machining has been performed on the castings.

Casting-to-casting dimensional variation is minimized and is limited by pattern accuracy, and by the care and control exercised by the foundryman during production. While limitations vary greatly with application, dimensional tolerances in the order of .002 to .005 in. per inch within one shell, and .005 to .0012 in. per inch across a shell parting line, are possible. Such close dimensional tolerance facilitates jigging and expedite multiple machining operations.

Due to the lack of moisture in shell molds, the grain structure on the casting surface does not show the usual "skin" effect of a hard, fine-grained, orientated structure characteristic of some green sand castings. The grain structure in shell molded castings consists more nearly of uniform, equiaxed grains throughout the cross-section.

Because of the faithful reproduction by the shell mold of the metal pattern, and through the use of relatively fine grain sands, very smooth surface finishes are obtained on shell mold castings. These surfaces enhance the appearance of the unmachined parts of the finished product, and often permit belt sanding to replace machining operations.

Lack of moisture in the shell molds increases metal fluidity and permits thin sections to be cast. This feature enables the shell molding process to produce castings for parts which could formerly be made only by fabrication methods. The excellent reproduction of surface detail also offers new applications to shell mold castings such as a shell cast aluminum impeller.

Using the same equipment and materials, practically any metal can be poured to produce shell molded castings. Castings are presently being produced in the full range of alloys from stainless steel to 10K gold.

The general cost estimates of suitable shell castings range from slightly below to slightly above costs for a cleaned green sand casting before machining.

There are some disadvantages in shell molding and one of the more important is the high pattern cost.

Because of the heat resistance required, and the dimensional accuracy which must be built into the shell molding patterns, the pattern cost is high. But on high production rate items, the unit pattern cost per casting becomes insignificant, since the patterns have a long production life.

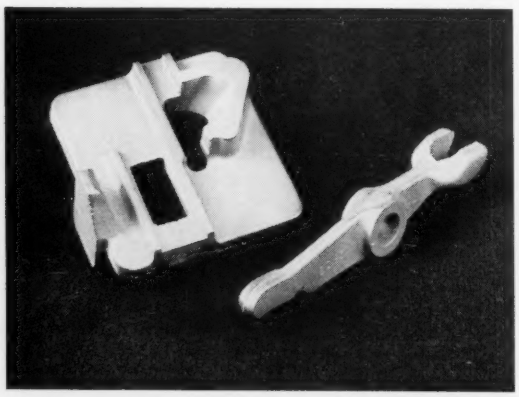
Size limitation is another disadvantage. Shell molding castings are generally limited in size to approximately 95 lb. There are, however, many exceptional cases of castings being made heavier.

The castings must be cheaper

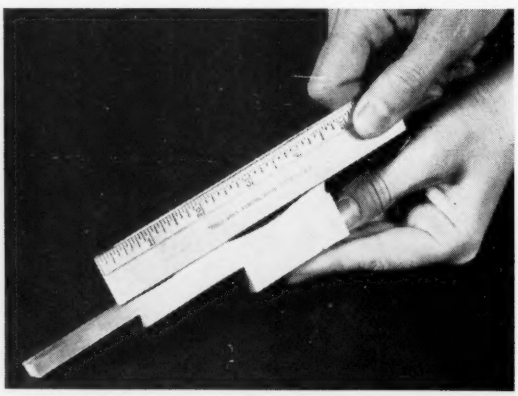
In order to profit by the process, the castings produced must be made either better or cheaper than those made by conventional methods. For example, little or nothing would be gained in setting up shell molding operations to produce annually a few hundred castings having neither strength nor dimensional specifications.

The most widespread successful applications of shell mold castings are found in high production areas such as the automotive, aircraft, farm machinery, and appliance fields. Typical examples are cam and crankshafts, valve stems, rocker arms, gears, housings, cover plates, pump bodies, valves, pipe fittings, hardware items, flat-iron bases, and impellers. Typical savings have been made in Part A in the picture (page 35) which required 28 hours of hand grinding plus extensive machining operations to finish. To reduce costs, it was tried in an investment process which resulted in lower finishing costs but higher casting costs. When it was made in the shell process, however, casting costs were only 25% of investment casting costs. Dimensional tolerances proved better than, and the surface finish was nearly equal to, that of the investment casting.

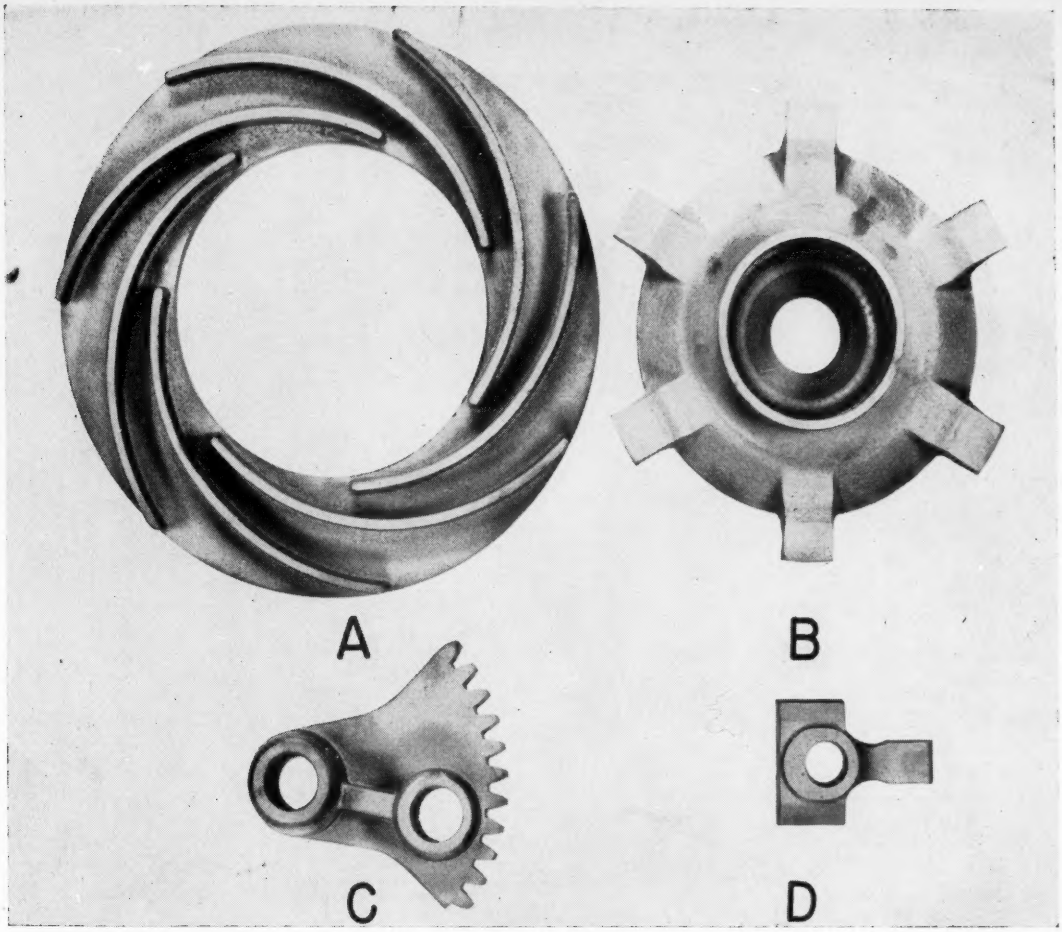
Part B, made of SAE 4140 steel, was originally a



Textile machinery parts as cast exemplify advantage of completely eliminating or reducing the machining.



A typical shrinkage pattern. Step bar was purposely poured without riser to find the shrinkage area.



Parts made by shell molding: A, cost 25% less than by investment casting. B, of SAE 4140 steel reduced machining over 60%. C, needed only a final hobbing. D, had four machining operations cut, weight 30% less.

With less complicated coating, mold, cores, will be blown instead of dumped

forging. Now made in the shell process, machining has been reduced over 67% with dimensional tolerances held to 0.008 in. on the 3¼ in. diameter.

Another Part, C, made of a high strength grey iron, was formerly cast in a permanent mold to guarantee close metal in the teeth. Now cast in shell molds, the teeth are cast with such good detail and accuracy that only a final hobbing operation is necessary. Weight was reduced 20 per cent.

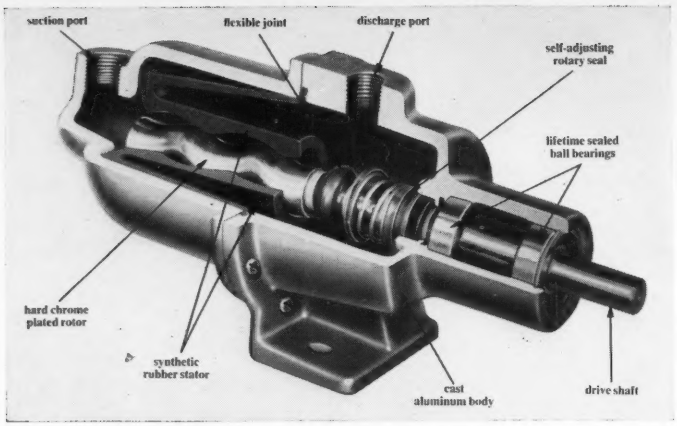
Made of high strength grey iron, Part D was formerly cast in a permanent mold. Now, cast in shell molds, four complete machining operations were eliminated and the weight was reduced 30%.

And a part made of grey iron, was formerly cast in green sand. Now produced by shell molding, the smooth finish obtained reduces finishing costs up to 50 per cent.

A part made of brass, was formerly a forging. Now a shell mold casting, the structure is pressure tight and the over-all cost of the finished piece has been reduced 67 per cent.

What is ahead for the shell molding process? Right now development is concentrated on the production of resin coated sands. With a less complicated coating process, an increase in the number of shells, molds and cores will be made by blowing rather than dumping. Already in limited production are such applications as blow stack molds, and in more widespread applications, blown hollow, or shell, cores. These cores may be used in both shell and green sand molds, offering the same advantages of smoothness and dimensional accuracy.

It is not surprising that shell molding has experienced a rapid growth since its introduction. In suitable applications, both casting producer and end user have weighed the advantages and disadvantages at the process. Result: More and more castings users are specifying shell molded castings. ★



Above, components of helical pump are shown in cross-sectional view.

Helical pump moves many mixtures

Reversible, it pumps in either direction with high efficiency at low volume

Pump is self-priming and capable of high suction lift, metered uniform flow

ANYTHING THAT WILL flow through a pipe can be handled by the helical gear pump. Known as the Moineau (or Moyno) it consists of two main parts.

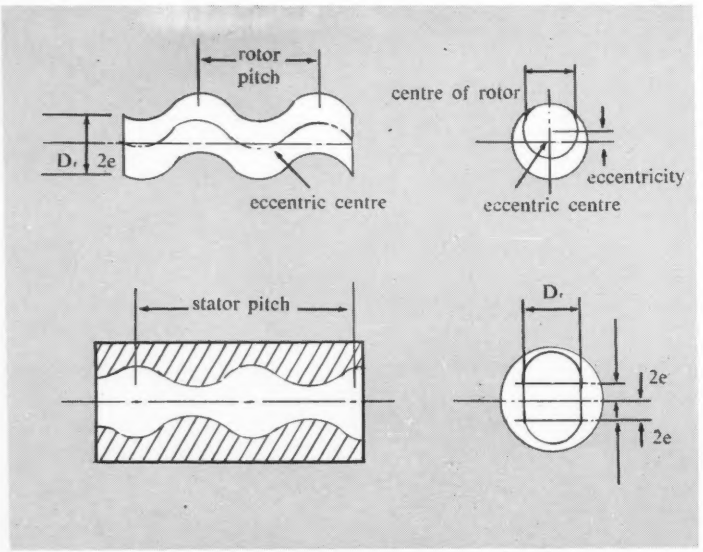
The rotor (picture 1) is a single-threaded element, each cross-section of which perpendicular to the axis forms a perfect circle. The centre of these circles is, however, displaced from the centre of the whole part, as shown by the end-view.

The stator (or stationary element) (picture 1) is a double-threaded part whose *"lead"* is twice that of the rotor. In section it consists of two semi-circles connected by a rectangle. The diameter of this formed circle is equal to the diameter of the circle formed at any perpendicular section to the longitudinal axis of the rotor.

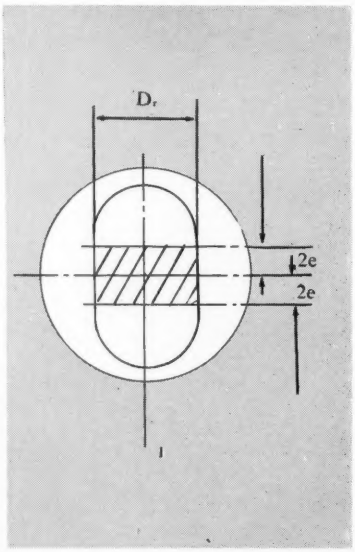
The rotor fills in that area of the stator formed by the two semi-circles and leaves unfilled the area equivalent to the shaded rectangular space (picture 2). It is this space that makes up the void which carries the liquid. The void is expressed in area as $4eD_r$, where e is the eccentricity and D_r the diameter of the rotor section.

The stator or stationary element (picture 1) is a L is the length of the stator thread, and the displacement of the pump is $4eD_rLN$, where N is the rpm.

During each revolution, the liquid carried in the



Picture 1. Rotor is single threaded, stator double threaded.



Picture 2. Rotor fills two semi-circles.

voids between the rotor and stator progresses continuously toward one end of the stator thereby giving the pump a positive and uniform discharge.

As any liquid-carrying cavity is sealed off, another cavity is fully opened and at intermediate points two cavities will be discharging liquid at the same time. It can be shown mathematically that the total displacement is constant.

The velocity of the liquid entering the pump is the same as the discharge velocity. This limits the capacity of these pumps but at the same time has the advantage that there is minimum turbulence in the pump.

There are advantages on one hand and disadvantages on the other to this type of pump.

Advantages: Self-priming, capable of high suction lift; positive displacement; metered uniform flow; low internal velocity; handles large particles in solution; high efficiency at low volume; reversible, since it pumps equally well in each direction of rotation; capable of delivering relatively high pressures; handles highly viscous materials with ease.

Disadvantages: The pump is limited to a capacity of 500 gpm; requires a flexible drive member; in general requires extreme accuracy in manufacture and consequently is costly; the physical size is greater than for other types of pump; the eccentric motion of the rotor (dynamic unbalance) limits the speed of the pump.

This pumping principle has been used successfully in the chemical industry, in food handling, in the ceramic field, in paper mills, and for handling water, oil, paint, varnish, cement, glue and so on.

It handles liquids varying in viscosity from liquefied gases to semi-solids, and volumes of from less than 1 gpm to more than 200 gpm, at pressures up to 1,000 psi.

Usually, pumps of this type are engineered to fit specific applications, with careful consideration paid to speed and so on.

The rotors are usually made of high carbon, high chrome, air-hardening tool steel, for maximum abrasion resistance or of Type 316 stainless steel for corrosion resistance.

By experience it has been found that the addition of heavy layers of hard chrome plating to the surface of the rotor increases the abrasion resistance.

Stators are made of molded rubber, molded synthetic rubber, tool steel, stainless steel or bakelite. Molded rubber and synthetic rubber stators are the most common and are always used unless the liquid to be handled affects them chemically or because the temperature is excessive. Correct application of this pump requires complete knowledge of the liquid to be handled and the operating conditions. Highly abrasive liquids require low speed, soft natural rubber stators, high abrasion-resistant rotors and a sufficient number of pumping elements to reduce slippage to a minimum.

Temperatures greater than 150F usually require rotors be made undersize to allow for thermal expansion of the rubber stators. Temperatures in excess of 200F cannot be handled by rubber stators. Liquids which cause deterioration of natural rubber will require synthetic rubber stators or even metal or bakelite stators. If metal stators are required the viscosity becomes important. ★

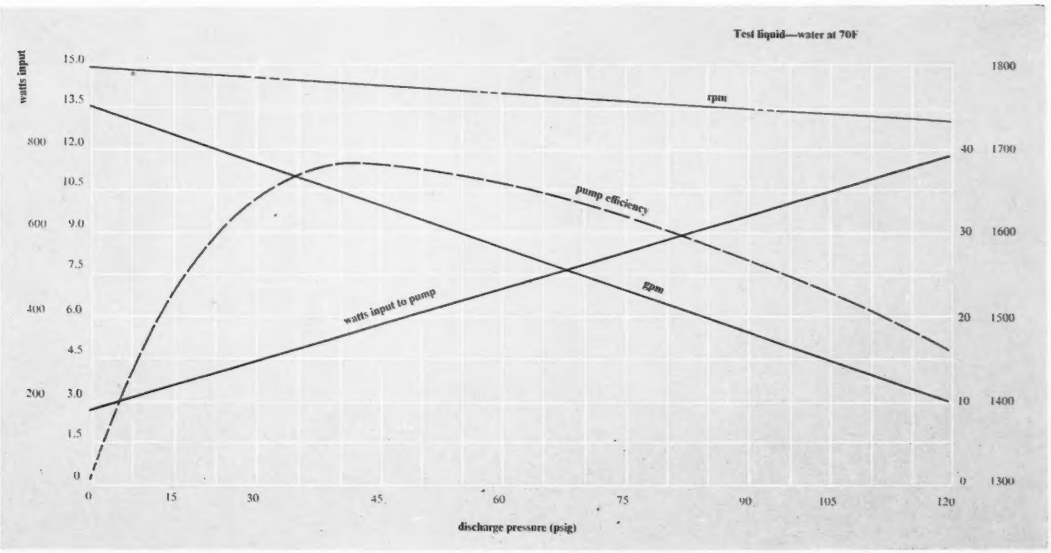
DIMENSIONS

Model	Overall Dimensions Length	Height	Width	Shaft Dia.	Port Size Suction	Discharge	Ship. Wt.
EC-22	12⅝"	5⅛"	4¾"	⅝"	¾"	½"	6 lb
EC-33	12⅝"	5⅛"	4¾"	⅝"	¾"	½"	6 lb
EC-44	12⅝"	5⅛"	4¾"	⅝"	¾"	½"	6½ lb
EC-55	17⅝"	8 1/16"	7⅝"	¾"	1½"	1¼"	32½ lb

Pump sizes (above); What they will do (below).

CAPACITIES AND PRESSURES AT 1,750 RPM

Lb. Press.	Model EC-22 gph	HP	Model EC-33 HP	HP	Model EC-44 HP	HP	Model EC-55 HP	HP
0	320	¼	516	¼	800	¼	1250	½
50	240	1/3	336	½	670	½	780	1
150	60	1						



Pump efficiency is illustrated in broken line curve above, which was based on test with water at 70 deg. F.

Tube, bonded the Al-Fin way, weighs 98 lb. Conventional copper increased weight 127 lb.

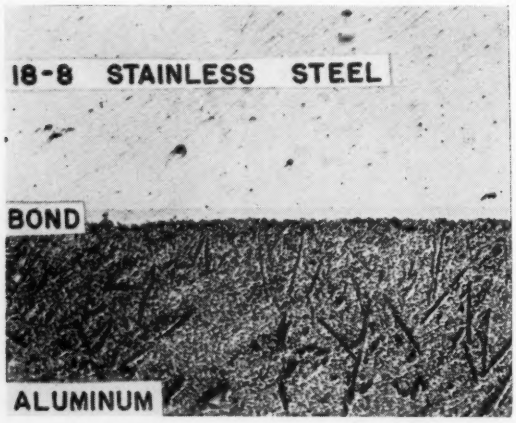
Al-Fin bonds aluminum to stainless steel

By H. W. CRUSEY
FAIRCHILD CORP.

Combinations of material problems are met and solved by the new process

A NEW TOOL for design engineers faced with materials problems requiring a combination of heat transfer, light weight, electrical conductivity with strength and hardness, will be found in the Al-Fin process. It makes possible the metallurgical bonding of aluminum and magnesium casting alloys to ferrous metals, nickel and titanium. The process is being used in products ranging from classified nuclear energy devices to frying pans and pressing irons.

Al-Fin requires only one more step than is used in the manufacture of light metal castings. It consists essentially of immersing the ferrous member in a bonding bath immediately before putting it in the mold which is then filled with the desired light metal alloy. During the immersion phase an inter-metallic layer is formed on the surface of the ferrous metal consisting of a thin film of ferro-aluminum alloy. In the subsequent casting phase the light metal alloys with the ferro-aluminum alloy, resulting in a bond having a tensile strength of 15,000 psi and a shear strength of 8,000 psi. The microphotograph illustrates a typical bond between stainless steel and No. 43 aluminum alloy.



Microphotograph, above, shows the typical bond between stainless steel and number 43 aluminum alloy.

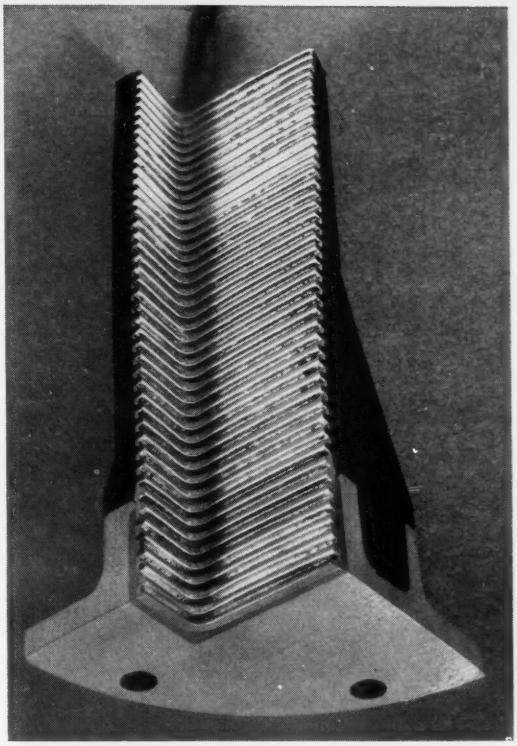
Developed originally for the manufacture of aluminum-finned, steel cylinder barrels for aircraft engines at the end of the war, the process was quickly adapted for use in high output automotive truck and bus engines where increased engine loadings have made armored top compression ring grooves mandatory for long life.

This construction has also been used by Alco Products of Schenectady, New York, for their No. 244 diesel locomotive engine. The 9 in. diameter by 10½ in. long forged aluminum piston is designed with a separate ring carrier in order that oil circulation grooves can be provided for cooling the piston rings. Originally all-aluminum ring carriers were pressed onto the forged piston and welded in place. This construction proved unsatisfactory because of rapid top compression-ring-groove wear and has been superseded by bi-metallic ring carriers of cast aluminum with a bonded-in Ni-Resist carrier to protect the top compression groove where maximum wear occurs. The bi-metallic ring carrier band is pressed onto the forged aluminum piston and heliarc welded to it around the crown to prevent oil leakage. The piston forgings are of Alcoa 32S-T6 and the bonded bi-metallic ring carriers are of Alcoa A132-T551. An austenitic high nickel cast iron

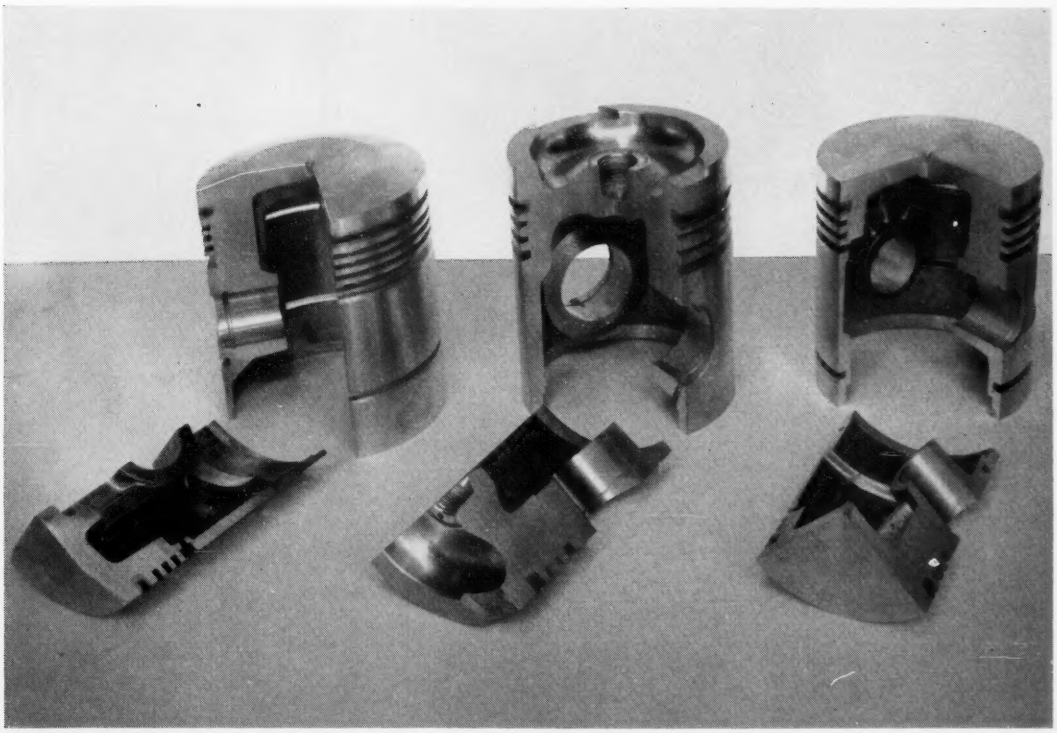
Ni-Resist 1A is normally used for the ring carrier insert.

The demand for less weight and more electrical output for high frequency generators used in jet and turboprop aircraft has led to aluminum alternator housings with bonded-in silicon iron lamination stackings. Aircraft speeds have been increased to the point where air cooling is no longer feasible because the ram air temperature exceeds the limits of electrical wiring insulation materials; so these alternators are cooled by means of the hydraulic servo oil utilized for actuation of servo equipment. This liquid cooling is accomplished by either circulating the oil directly in contact with the aluminum stator housing or by pumping it through stainless steel tubes bonded into the aluminum housing. The advantages of this light weight, high thermal efficiency construction are very real since each pound of aircraft accessory weight costs at least $500 because of increased power required, the increased fuel consumption, fuel storage, and necessarily larger airframe.

In the field of electronics, aluminum cooling radiators for power tubes and electronic gear offer the advantages of light weight and costs lower than those of copper. The disadvantages previously encountered with soldering of aluminum have been solved by the bonding of nickel or ferrous inserts into the desired cast aluminum structure. So it is possible to solder the ferrous or nickel component to the desired copper or ferrous alloy component such as in the case of the cooling radiator and the typical wave guide flange (see pictures). In these applications the Al-Fin molecular bond means no impediment to the flow of heat across the interface even at elevated temperatures where ordinary inserts would loosen because of differential expansion. And with this bonded construction there can be no galvanic corrosion along the inter-face, simply because



Cross-section of flexible tubing flange, coupling made by Al-Fin bonding steel insert into aluminum flange.



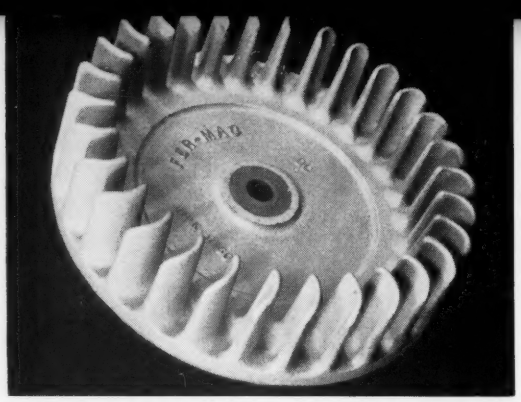
Aluminum pistons with ring carrier bands that have been bonded-in by the Al-Fin process are shown in sections.

Al-fin bonding *(Continued)*

there are no voids present for the accumulation of liquids which could set up an electrolytic cell.

Al-Fin connectors are in use in diverse places where it is desired to obtain pressure-tight, leakproof joints between aluminum and ferrous parts. This construction is illustrated by the Alco piston (mentioned earlier) as well as by the picture showing how simple tube connectors can be made for joining aluminum refrigeration tubing to the ferrous evaporator and compressor components. In such cases a simple muff is bonded and cast to the desired length of ferrous tubing. The aluminum muff is then heliar-welded to the wrought aluminum part and the steel part brazed or welded to its mating component. Mass spectrometer tests (DESIGN ENGINEERING, January) on such bonded joints have indicated a leak rate so low that over 100 years would be required for the escape of the Freon used in a well-known manufacturer's home type refrigerator.

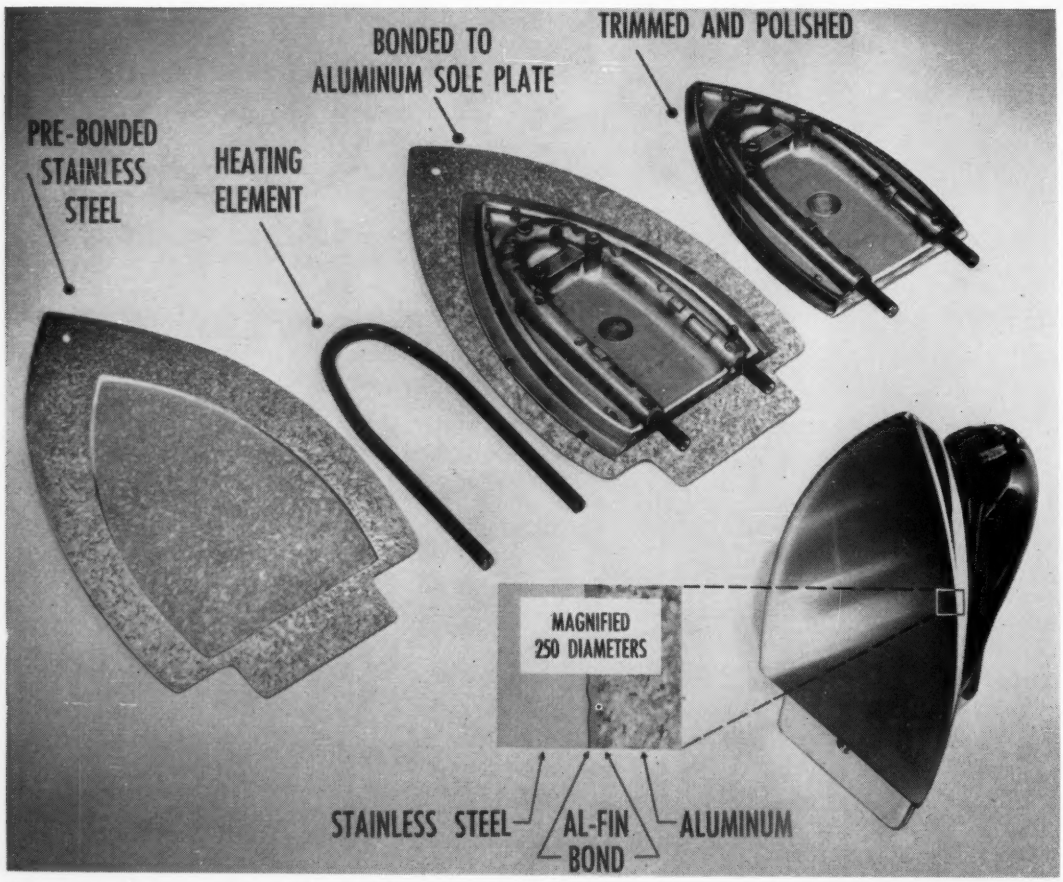
This same construction is being used in rocket and missile engines to facilitate the connection of the high



Cooling fan and flywheel magnesium casting were metallurgically bonded to steel hub by Al-Fin process.

temperature ferrous components to the low-temperature, light-weight aluminum sections. The housewife's demand for utensils of stainless steel for their ease of cleaning and gleaming appearance has created a brisk demand for cooking utensils of this material. Unfortunately, stainless steel proved unsatisfactory for cookware because of its low thermal conductivity which prevents the uniform distribution of heat. Then the low thermal conductivity of stainless steel led to

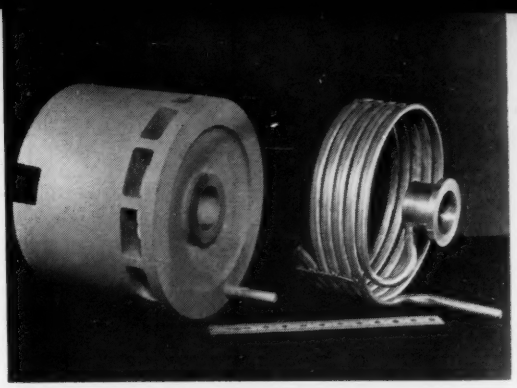
Heat transfer, light weight, electrical conduction, strength and hardness



Stages are shown in making bonded bi-metallic soleplates for electric iron with magnification of final result.

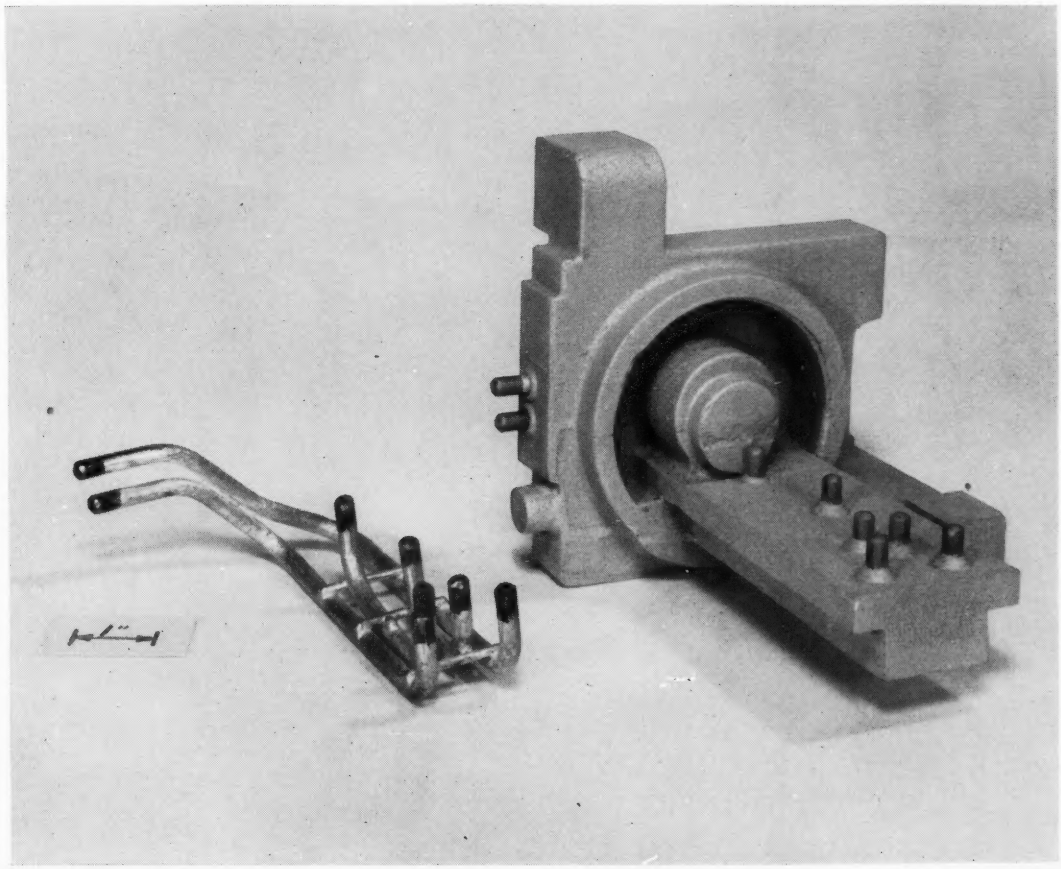
aluminum-bottomed, stainless steel cooking utensils consisting of 0.025 in. thick stainless cooking container with ⅛ in. thick Al-Fin bonded-on cast aluminum bottom. The bonding of the cast aluminum is done in permanent molds permitting a minimum of machining to produce attractive low-cost cooking ware. S. W. Farber Inc., manufactures a complete line of bi-metallic frying pans, sauce pans and sauce pots and has now introduced a series of electric table-top frying pans of stainless steel with resistance heating element imbedded in the bonded on aluminum bottom. These table-top units are equipped with a detachable thermostatic control which can be removed for complete immersion when washing. And Sunshine Waterloo Co. will soon be manufacturing such cookware, under Al-Fin license, in Canada.

Concurrently with the development of the light-weight pressing iron and its successor, the light-weight steam iron, objectional features soon appeared in the major weight-saving component, the aluminum soleplate. These included porosity in the soleplate, which caused high manufacturing scrap after partial finishing, and customer sales resistance because of poor appearance; raising of burrs on the soleplate when pressing garments containing hooks, snaps and zippers which subsequently caused snagging threads in delicate fabrics; and corrosion around the steam ports. These problems have been solved by Al-Fin bonding thin stainless steel bottoms, of the order of 0.012 in. thickness, to the die cast aluminum soleplate. Pressing irons using bonded bi-metallic die cast soleplates are in production by Rival Manufacturing Co. for their Steam-O-Matic model. Other manufacturers are perfecting their manufacturing procedures and will soon have Al-Fin soleplates on their production irons. ★



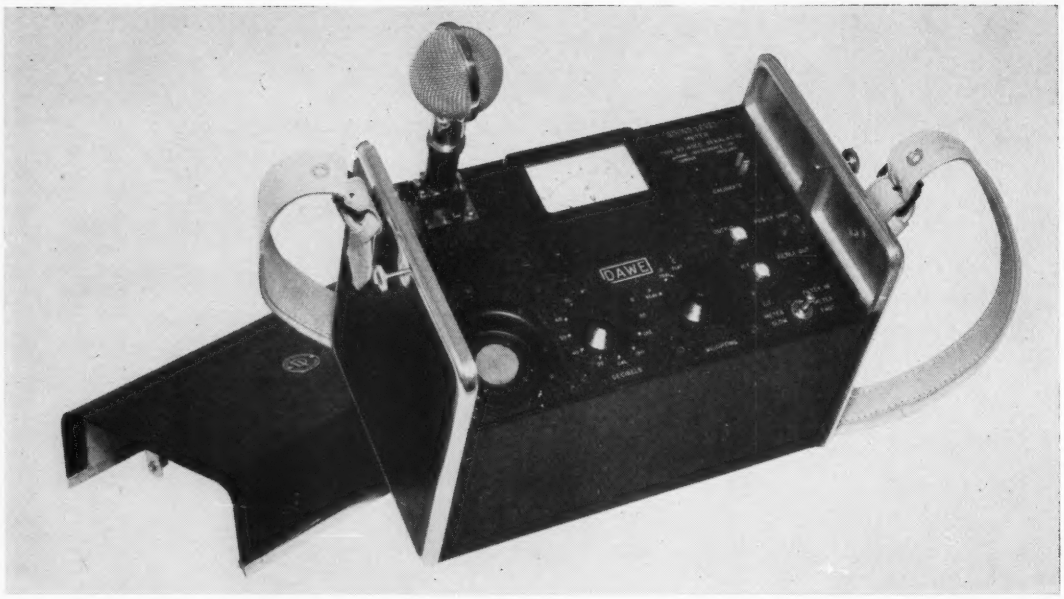
Magnesium hydraulic manifold casting with bonded-in stainless steel preformed tube cluster acts as value, mount.

are offered by process in products from nuclear devices to a pressing iron



Aircraft alternator housing of cast aluminum alloys with bonded-in helical tube coil and coolant bushing.

Noise is cross-examined by electronics



Picture 1. Meter equipment acts as electronic ear. Microphone responds to frequencies from 25 c/s to 8,000 c/s.

Persecuted by unpleasant sounds at his work and during his pleasures mankind looks for release. Several new measuring devices will help him

By S. A. RYBB, B.Sc.

DAWE INSTRUMENTS (CANADA)

NOISE IS BECOMING too big a part of life. The further our technical civilization goes forward, the more it runs into noise. Yet quite small amounts of noise are tiring—and enough of it can do physical harm. So it is a serious problem; designers are beginning to find it an important part of the design challenge and will find it more so as time goes on.

There are few places where the modern man can find quiet. The home, for instance, is equipped with a glut of noise-making devices; there is the refrigerator, vacuum cleaner, polisher, fan, air-conditioner, and other audible appliances. Outdoors it can be worse; here the human ear is assailed by cars, airplanes, railways and a profusion of other clattering things. And at our work there is the machine; from the typewriter to the machine-shop grinding wheel, modern equipment is speeding our work at the price of higher and higher levels of sound.

Each time a machine rotates, reciprocates, starts or even stops, vibrations are set up which are transmitted to the surrounding air. When they reach the ear a sound is heard and, if the sound is unpleasant, we call it noise.

Noise splits into two categories: There are the tactual vibrations of the operating machinery and the noise produced as the result of vibrations.

Vibrations may cause machines to wear out much more rapidly than would otherwise be the case; this wear in turn increases the vibrations, which again increase wear and so on, setting up a vicious circle.

The noise produced by machinery vibrations has impact on humans. Mankind has not yet become either sufficiently accustomed to noise, or is it immune from its effects. Neither can man shut it out of his consciousness nor resist its impact on his nervous system. Noisy household equipment in the home can make its occupants feel irritable and inclined to become fatigued. Similarly, in offices or plants, operators exposed to a

high noise level cannot well concentrate and tire more quickly. This fatigue and lack of concentration increases the rate of error and retards productivity. Noise also tends to mask speech, making it awkward to pass on the instructions in noisy surroundings, causing delays and errors.

Vibrations and consequent noise level should be reduced, wherever possible, in the interest of general wellbeing, as well as efficiency, productivity and equipment conservation. There is no doubt that less noise in the more highly populated parts of the world would be beneficial to our health and happiness.

Let us consider a more concise definition of noise and sound. It was mentioned previously that noise is an unpleasant sound, which is its best definition, not only stressing its subjective nature, but also indicating one of the main reasons for the measurement of sound levels. The sound can be defined as the vibrations passing through the air. Those vibrations are seldom generated in the air itself but, usually arise in some vibrating object, which causes the surrounding air to vibrate in sympathy. The frequency of the vibrations generated within an object can theoretically lie within any range, but the air vibrations that can be heard by the average ears lie within the range of about 16 cycles to 18,000 cycles per second.

Sound waves possess two main characteristics: The pressure exerted by the alternate compression and rarefaction of the air at any given point, and the rate at which alternating pressure peaks follow one another. The first of the characteristics determines the intensity of the sound, and the second determines its quality.

The ear is a detector of sound, and basically, without it there can be no sound. The effect of a particular sound on the observer will vary from person to person. Apart from true deafness, a person may be hard of hearing, which is permanent, or may suffer a temporary reduction of the acuteness of hearing.

A person exposed to a loud sound for a long time, will react less to high noise levels. In addition, sound waves are rarely of a pure nature, that is, of only one given frequency. Normally encountered sound is a complex wave consisting of a number of sound waves of different frequency making up the frequency spectrum. Humans respond differently to different frequency spectra. For example, a young person can usually hear the very high pitched cry of a bat, but an older person usually cannot.

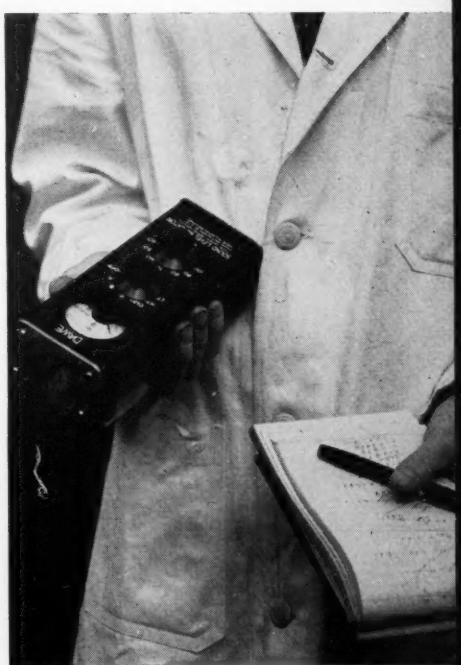
How well do we hear?

These factors make it difficult for the human ear to be a sufficiently reliable guide to noise measurements. For this reason, a range of instruments has been developed to provide a quantitative and qualitative information on sound measurements.

To obtain consistent figures realistic acoustical measurement and analysis, it is necessary to establish certain references, which must also be related to the sensitivity of the human ear. Unfortunately for the designers of such instruments, the response of the human ear to sound varies not only with loudness but also with frequency. The acoustical research by H. Fletcher and W. A. Munson led to a set of so-called equal loudness curves, which represent the response of an average human ear to different frequencies of sound. These curves are shown in graph 2, and are based on the response of a group of average observers in whom the sounds gave rise to no strong emotions.

This graph represents the intensity of sound plotted against the audible frequency range. The intensity

Noise	Decibels	Relative Energy	Pressure	Source (Examples)
				Threshold of feeling
	120	10^{12}	200	
				Thunder
				Gunfire
Deafening	**110**	10^{11}		Pneumatic drill
				Steam whistle
				Large machine shop
	100	10^{10}	20	
				Underground railway
				Busy street
Very Loud	**90**	10^{9}		Noisy factory
				Inside airplane
				Loud public address
	80	10^{8}	2	
				Noisy office
Loud	**70**	10^{7}		Suburban train
				Typewriter
				Radio set—full volume
	60	10^{6}	0.2	
				Large shop
				Average office
Moderate	**50**	10^{5}		Quiet motor car
				Quiet office
				Average house
	40	10^{4}	0.02	
				Public library
Faint	**30**	10^{3}		Country road
				Quiet conversation
				Rustle of paper
	20	10^{2}	0.002	
				Quiet church
				Still night in the country
Very Faint	**10**	10		
				Sound-proof room



Picture 2. Survey meter is a pocket-size unit, easily operated and particularly valuable for large area coverage.

Noise measurement *(Continued)*

is expressed in decibels, the decibel being defined as the logarithm of the rate of flow of energy per unit area. One decibel is about the lowest change in sound level that can be detected by the human ear. The general formula is expressed in the following terms:

$$db = 10 \log_{10} (P/P_o)^2 = 20 \log_{10} P/P_o$$

Where P_o is the reference sound pressure, accepted internationally to be 0.0002 dynes per sq cm, and P is the actual sound pressure.

The curves are plotted by finding, for each frequency, the sound intensity which appears to be of equal loudness to a pure 1,000 cycles per second note of 10 db for instance. This procedure is repeated for a range of decibel ratings. The decibel rating of the sound of 1000 c/s which appears to be of equal loudness to the sound being measured is known as its rating in phons. Each of the sounds on a particular "equal loudness curve" in graph 2 has, therefore, the same phon rating. At 1000 c/s the phon and decibel ratings of a sound are equal by definition.

"Since the equal loudness or phon curves enable sounds at different frequencies to be corrected for their differing effects on the human ear, the frequency response of all modern sound level meters is adjusted to certain specified equal loudness contours by using weighting networks.

The phon is defined in British Standards in terms of a subjective measurement and the weighted response is defined as the sound level in decibels. It should be mentioned that some countries, for example Germany, refere to the weighted response as phons.

Because of the logarithmic nature of the decibel scale, two readings in decibels cannot be directly added. Thus two sounds of 70 decibels will combine to give a sound of 73.01 decibels, since 10 $\log_{10}$ 2 = 3.01, and not twice 70 or 140 decibels. For each rise of 10 db, the human ear does in fact hear roughly a doubling of sound level. This shows the falling-off in sensitivity of the ear as the loudness increases, since the rise of 10 db represents a ten-fold increase in sound energy.

Since a normal human ear can just perceive a sound of 0 db and can stand sounds up to 120 db for short periods without lasting damage, the ear will detect a wide range of sound pressures between 0.10002 and 200 dynes per centimeter square.

The sound level meter can be considered as an electronic ear. A crystal microphone acts in a similar fashion to an ear drum. The mechanical energy of the sound pressure is picked up by the microphone and converted into an electrical signal. This electrical signal is magnified in an amplifier and fed to a suitable indicating meter. Due to the low pressures involved in all normal sounds, it is essential to have a powerful amplifier and this was not possible before the advent of modern electronic techniques.

The sound level meter shown in picture 1 has been designed to meet the requirements for sound level measurements as described.

The equipment consists of a sensitive crystal microphone, a calibrated attenuator, a high gain amplifier with appropriate filter networks, an indicating meter and self-contained batteries.

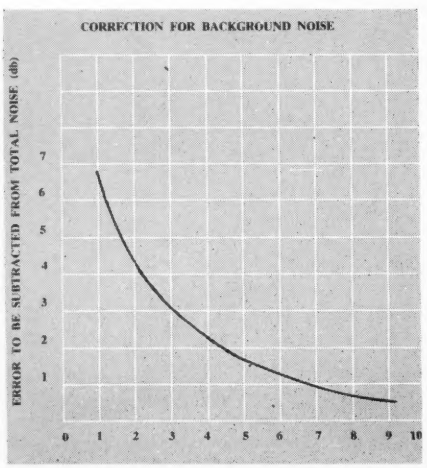
The microphone is of the Rochelle-salt, crystal-diaphragm type, which has a substantially level frequency response from 25 c/s to 8000 c/s. The series capacitance of the microphone is nominally 5000 micro-micro-farads at 20 C, but varies with temperature, being about 4000 mmf. at 10 C, 9000 mmf. peak at the Curie point 23.8 C and falling again to about 4000 mmf. at 30 C.

The output of the microphone is fed into the first section of the attenuator. The second section of the attenuator is located between the second and third stages of the amplifier. This division of the attenuator into two sections, is adopted to avoid over-loading in the amplifier stages. The Decibels switch, mounted on the front panel of the instrument provides eleven steps of attenuation, each of 10 db.

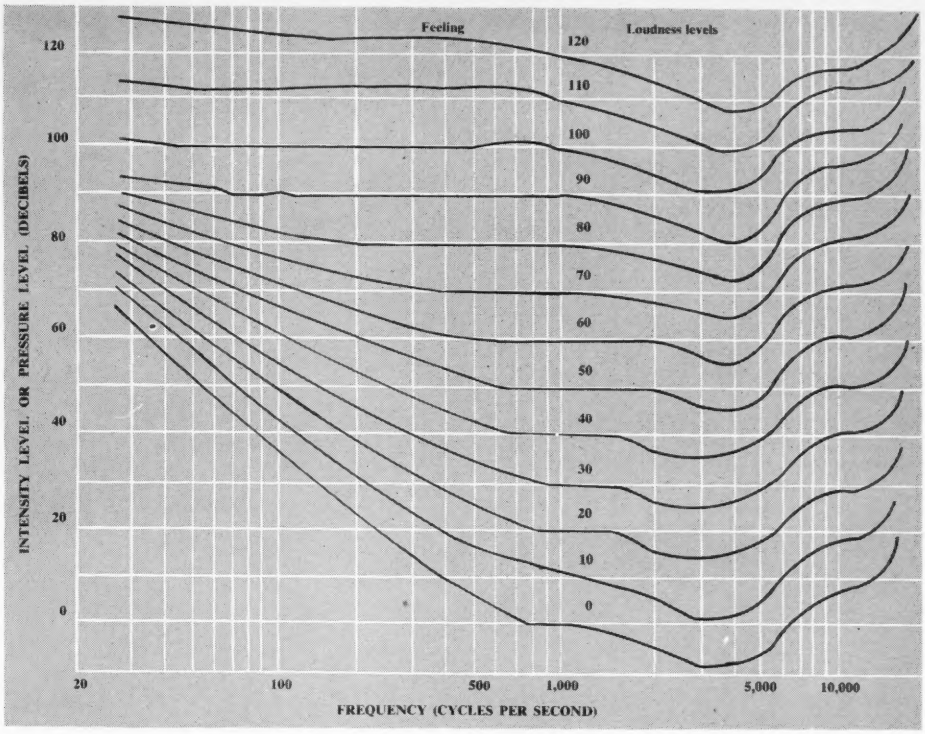
A six stage amplifier unit has subminiature tubes and components to provide a compact assembly and economy in battery consumption. Negative feedback is used to stabilize the gain and improve the over-all frequency response. The subminiature tubes are relatively immune to microphony and a further reduction of the effects of external vibrations and noise is achieved by cushioning the first three amplifier stages and supporting the complete amplifier assembly on resilient mountings. Separate output stages are used to operate the meter and an output jack.

The frequency response of the human ear is simulated by the filter networks, called "weighting." Most sound level meters provide three of those weighting networks, which are filters having frequency characteristics similar to those of the human ear, along three equal loudness contours. This is necessary because of the obvious impossibility of varying a single network continuously in the same way as the human ear. The three weighting networks, recommended both by American and British standard specifications are those representing equal loudness curves at 40 and 70 phons and a "flat" position, which gives a flat frequency response within the frequency range of the instrument.

On examining the Fletcher and Munson curves (graph 1) it can be seen that curves of approximately 90 phons and above are nearly flat between 25 and 8000



Graph 1. Difference between total noise and background alone with all data in db.



Graph 2, showing equal loudness contours. Each sound in contour has same phon rating.

Normal response of meter is rapid, simulating the human ear

c/s, this frequency range being normally the range of most sound level meters. So, for low sound levels up to about 55 or 60 db, the meter is switched to the first filter, that is 40 position. For medium sound levels, between about 55 and 85 db, it is switched to the second filter, that is 70 position.

For very loud sounds, above 85 or 90 db, the third filter, that is flat position is used. There are errors introduced in this way, but they are not very large. As long as the correct filter, corresponding to the ambient sound level, is selected, the meter reading can be relied on to be consistently closer to the mean of a number of typical observers than the variations which may be expected within such a diversified group.

The instrument described here, employs four different filter networks. The first three follow the standard weighting curves as explained above. The fourth characteristic has an essentially flat response from 25 to 20,000 c/s. This latter position can be used for measuring sound levels having a high percentage of frequency components above 8000 c/s. This, however, necessitates the use of a special microphone, with a level response up to 20,000 c/s.

The "Filter In" and "Filter Out" jacks enable special filter networks to be inserted, when the sound measurement of certain frequency band is required.

The amplifier output is connected to a rectifier type meter. The meter scale is made approximately linear for decibels by biasing the movement and using specially shaped pole-pieces. It should be noted that the mechanical set zero of the meter is inoperative.

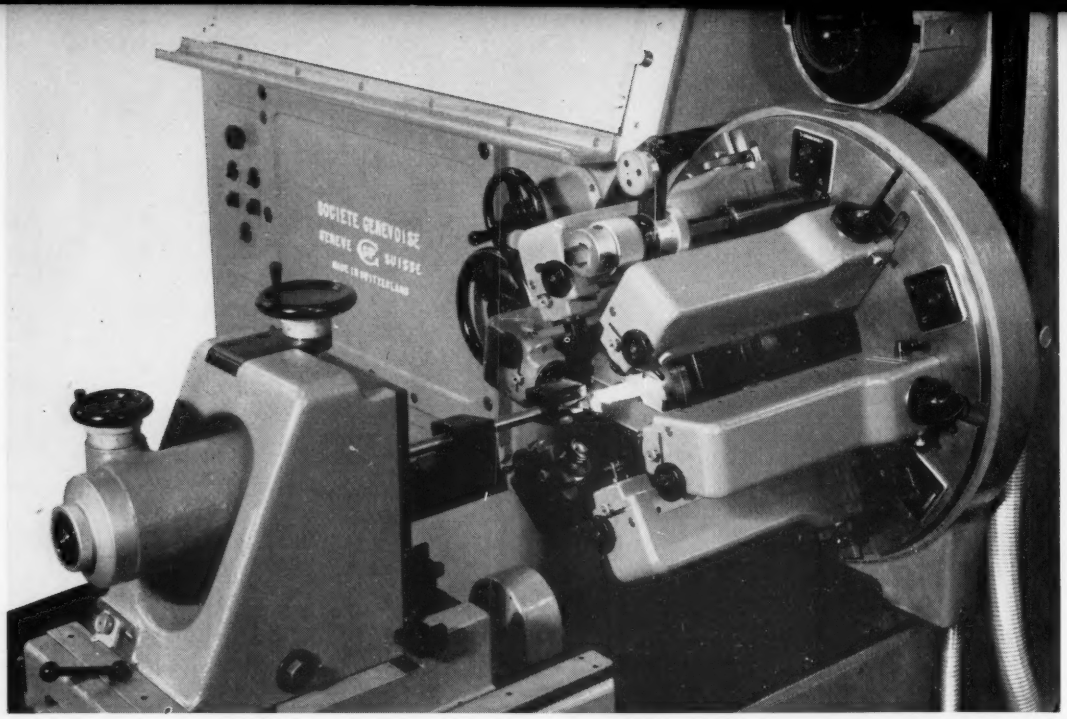
The normal response of the meter is very rapid, to simulate that of the human ear, and meets the speed requirements of the American Specifications, except toward the ends of the scale. The meter may be electrically damped to indicate fluctuating sounds.

The output jack may be used for connecting a pair of earphones for listening to the sound being measured or for connection to a sound analyzer. The latter instrument resolves the single reading of the sound level into its various frequency components.

The over-all acoustic calibration of the instrument is adjusted for a given microphone, which has been checked by comparison with a standard reference microphone. The gain of the amplifier may be checked and reset at any time using an alternating current supply. The reading obtained by connecting a fraction of the line voltage directly to the meter is compared with the output from the amplifier when the input is fed through an internal pre-set attenuator.

A simple control on the instrument panel, indicates when the capacity of the dry batteries powering the meter has fallen below the minimum value.

The actual sound level *(Continued on page 64)*



A blade is placed in position for viewing in the illuminating device, with part of screen visible at the left.

Plan to check blades' twisted contours

By J. A. OATES
A. M. I. Prod. E. (BRITAIN)

Cross-section of blade, magnified on screen, can be compared with a large master profile by operator

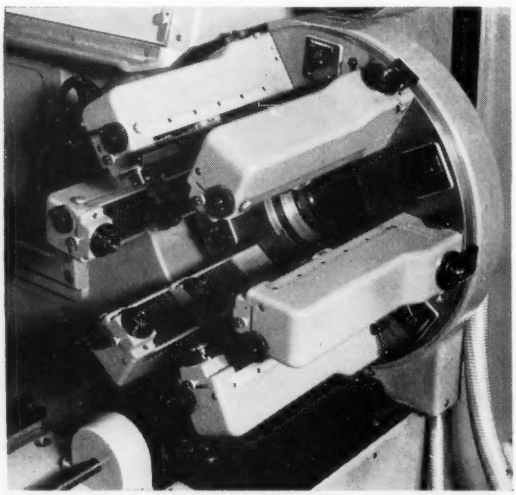
THREE DIFFERENT METHODS are now being used for checking the complex contours of turbine and compressor blades. They are:

1. The use of feeler, or stylus, which moves around the blade section to actuate some form of indicating mechanism—such as a pantograph working on a smoked glass plate; or it may be a device for steering a lens which projects a spot of light around a template. This system involves the stylus in moving completely round

Why you need inspection

Because of the very high operational speeds of turbine and compressor wheels, it is imperative to avoid even the slightest trace of out-of-balance which might set up dangerous vibration. For this reason, it is important that every blade of each set be identical. Again, if the maximum designed efficiency is to be obtained, the blades must conform exactly to the correct theoretical shape.

This means that very accurate means of inspection must be available for both research and production purposes. Unfortunately, in most cases the contours are very complicated and, also, alter throughout the length of the blade, and these factors have meant the development of entirely new types of gauging equipment.



Illuminating device with two groups of lamps showing screws for adjusting lamps at each end of each holder.

the blade section. Also, it needs contact between the gauging member and the blade. As some of the blades incorporate wafer-thin sections, distortion sometimes happens—even with the most delicate contacting mechanism.

2. Air gauging. With this method, selected spots around the blade profile are checked by a high-pressure air gauge system. Here, of course, only certain points on the contour are checked instead of the complete profile. So, while it is useful enough for passing or rejecting blades it gives the design engineer and tool setter little information for rectifying trouble. It does not show the actual shape being produced.

3. The last system is an optical one. It is the projection of a greatly magnified cross-section of the blade onto a screen where it can be compared with a large master profile. At no time during the test is any pressure applied to the blade. And every point around the profile is shown simultaneously.

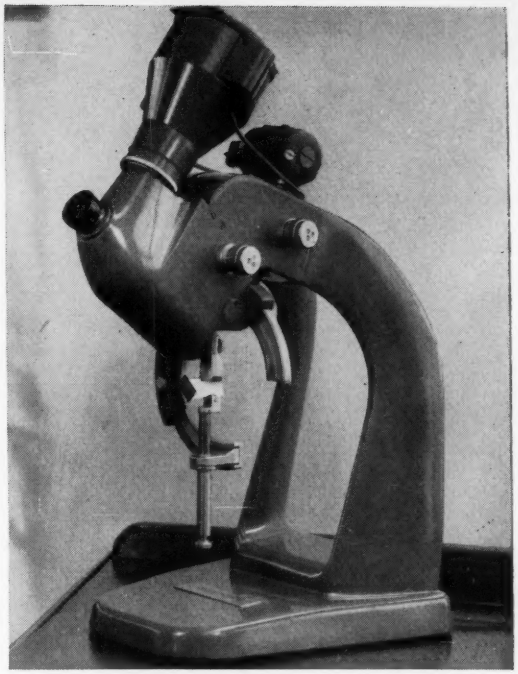
Several factors have to be taken into account when blades are being measured. There is the shape of each side (or face); the width and thickness; the amount of twist; the displacement of the tip section relative to the root section (known as the droop); and the radius of the leading and trailing edges.

It is claimed that, of the various types of inspection equipment mentioned, only the optical system permits all these factors to be checked. This method also has the added advantage that it provides a quick way of finding whether errors of one factor can be absorbed by drawing on the tolerances of others; this avoids the rejection of blades which would be needlessly condemned by the other system of inspection.

The optical system is used in the recently introduced Société Genevoise AP-15 projector developed specifically for the inspection of long and short plain and shrouded turbine blades, and also for a variety of solid shapes and components having curved or twisted surfaces. The principle employed involves delineating the section which is to be examined, before projecting the enlarged view of it on to a screen for comparison with a master profile. Two sections of the same object can be projected simultaneously.

A wide luminous belt is produced around the profile to be inspected by groups of six air-cooled lamps arranged in a circle. By means of diaphragms located in the six lamp-housings a sharp contrast can be obtained between the illuminated and the dark portions of the blade. The division between the two portions is in the focal-plane of the objective, and the image of the profile is projected on to the screen where it is compared directly with a master drawing at the same scale of magnification.

The diaphragms can be set to produce two types of illumination. If the *(Continued on page 53)*



This special Taylor-Hobson microscope is used for leading and trailing edges examination of turbine blades.

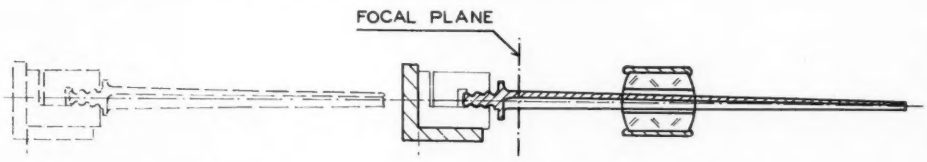
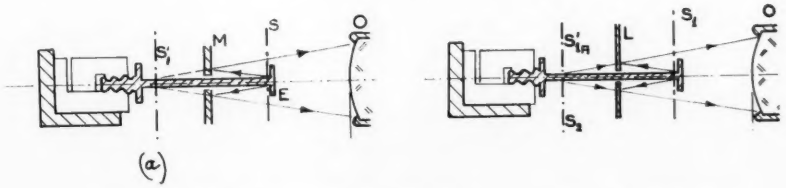


Diagram shows how long blades pass through centre of the annular lens



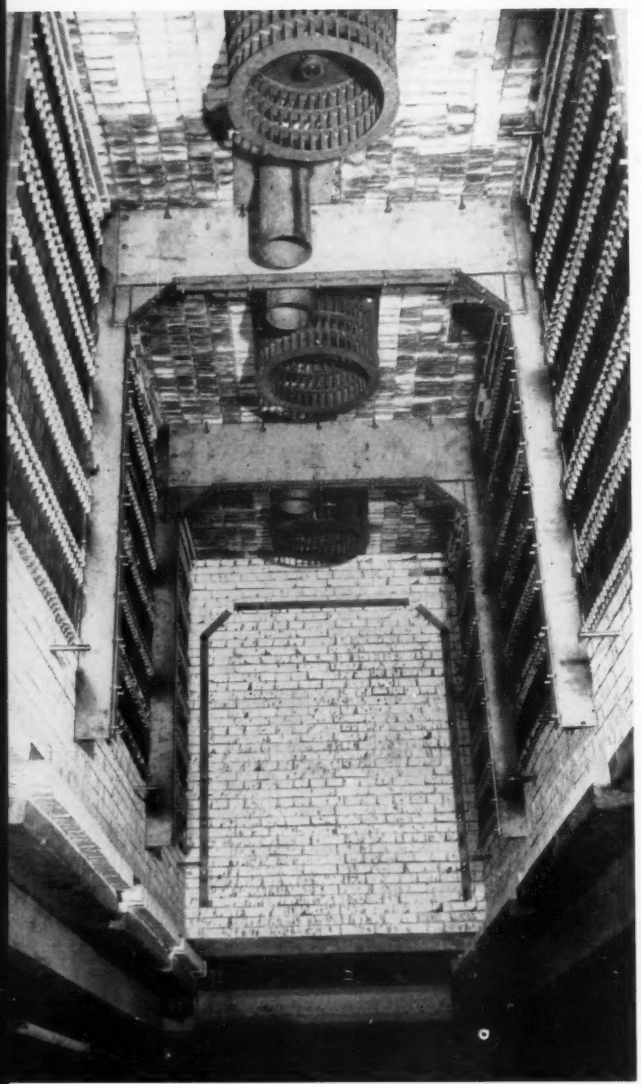
Projection theory using (a) mirrors and (b) semitransparent glass plates.

Method

How can you best heat treat aluminum?

By J. F. WHITING, P.Eng.
ALUMINUM LABORATORIES

Heat treating aluminum improves its mechanical properties. But the job has to be properly done. Here is how you can guarantee success with it



New air circulating furnace at Avro will be used to heat treat aluminum alloy, also develops high enough temperature — 1,450 deg. F. to heat treat titanium.

THE FURNACES USED FOR the heat treatment of aluminum, whether solution heat treatment, annealing or precipitation heat treatment, and so on, should be equipped with automatic temperature controllers and recorders to maintain and record accurate temperatures within the specified heat-treatment limits. The controllers and recorders should be of the potentiometric type, mechanically or electronically operated. These controllers are all readily adapted to furnaces heated by electricity, gas or fuel oil.

Thermocouples installed in the furnace should be of the chromel-alumel or iron-constantan type. Load couples are usually made of iron-constantan.

The load couple should be packed in a piece of aluminum having a diameter and length equal to the thickness of the thickest material in the load. It should be placed in the load at the location indicated by the furnace survey to be the last to recover to temperature.

The furnace controlling couples on the other hand should be located in the hottest spots in the furnace, directly in the path of the heating medium as it comes from the heating elements or burners. The load couple serves not only to indicate when the load has reached the desired temperature, but also as a check on the furnace controlling equipment.

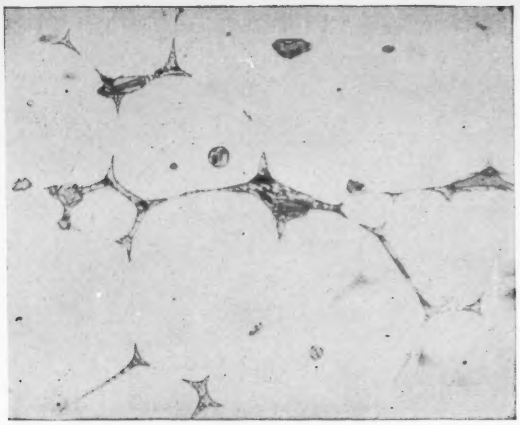
In commercial practice therefore it is important that the recommended solution heat treatment temperatures

How it began

In the first part of this article, which appeared in the November 1955 issue of Design Engineering, it was shown how the mechanical properties of aluminum alloys are improved by heat-treatment, with little sacrifice in ductility.

It was further shown how solution heat treatment gives a more even dispersal of the soluble alloying constituents in the aluminum matrix, explained by referring to the 4.5% copper-aluminum alloy.

And a description of the two classes of heat-treatment furnaces — air furnace and salt bath — concluded the article.



Picture 1: The incipient fusion in Alcan 24S sheet.

given for each alloy should be rigidly adhered to. The permissible temperature variation for solution heat treatment is ±3C. of the controller setting.

If too low a heat-treatment temperature is employed, incomplete solution will result and maximum mechanical properties will not be developed. Too high a temperature on the other hand, causes melting of the hardening constituents and rejection of the material.

Heat-treating time at temperature should commence when the coldest part of the load has reached the lower limit of the heat-treating range. The total time the load is in the furnace depends on the type of furnace, the thickness and nature of the material, the size of load and its spacing.

It is particularly important to ensure that the load is adequately spaced to permit free circulation of the heating medium. Castings usually require a longer time at temperature than wrought products, since their hardening constituents are in coarser form and take longer to dissolve. The recommended time at temperature for each alloy and product should be adhered to strictly if the best results are to be obtained.

The temperature ranges for annealing, precipitation heat treatment, stabilizing, stress relieving and growth removal are affected by the time at temperature. Therefore, such treatments are usually determined by experiment to find the most suitable combination.

Overheating of the metal during solution heat treatment must be avoided.

A micro-section of a piece of Alcan 24S sheet (picture 1) was deliberately heated to a point above the solid solution range. This shows in detail the characteristics of incipient fusion, namely, the formation of a weak, brittle material which greatly reduces strength and elongation.

The presence of incipient fusion is not readily discernible by visual examination of the heat-treated material and hence the only reliable safeguard is to ensure that the part is not heated above the recommended limits.

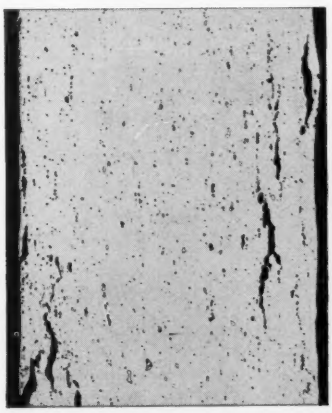
High temperature blistering (or high temperature oxidation) may result from the exposure at elevated temperatures of some aluminum alloys to atmospheres containing water vapor, ammonia or sulphur compounds, such as would be present in the products of combustion of gas or oil. Particularly in alloys containing substantial amounts of magnesium, the surface of the metal may become dull grey, or even black in severe cases, and covered with many fine blisters (picture 2).

The damaging nature of the attack is readily seen in (picture 3) as it progresses down through and around the grains, forming eruptions, and giving the sheet a characteristic blistered appearance. It has been found that very small quantities of certain chemical compounds, when added to the furnace with the charge, will vaporize and create an atmosphere which protects the metal from such attack. The photomicrograph (picture 4) shows the normal cross-section produced in another piece of sheet, heat treated in the same air furnace, but with protective compound added, thus creating a controlled atmosphere.

Prolonged holding at the heat-treatment temperature, or several repeated treatments, do little harm to most aluminum alloys but for certain forms of aluminum such a practice may reduce their effective resistance to corrosive attack. Such a case is that of Alclad sheet. Two photomicrographs (pictures 5 and 6) of Alcan 24S-T Alclad sheet, were originally from the same piece of 0.032 inch material, but were held at heat-treatment temperatures for periods of 30, and 120 minutes respectively.

A change is apparent in the coatings as the alloying constituents, under the impetus of heat, diffuse out-

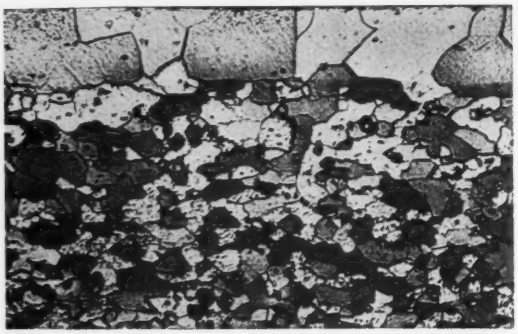
Picture 2: High temperature blisters in alloys containing magnesium.



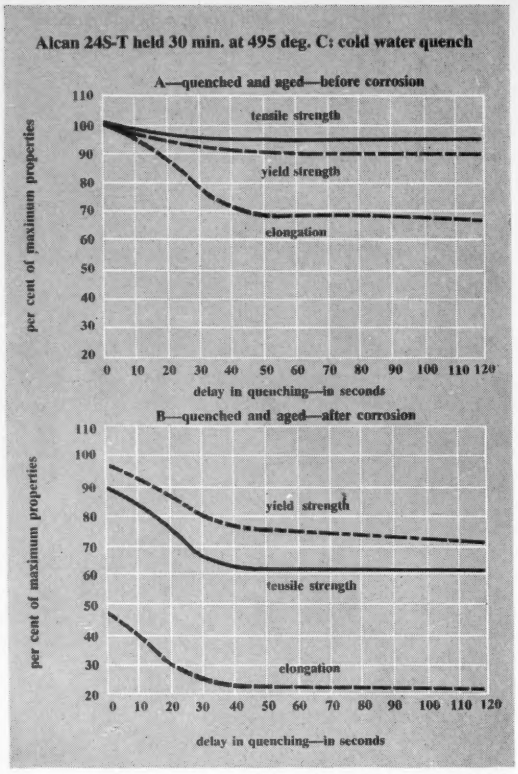
Picture 3: Damaging nature of attack progresses through and around grains.

Picture 4: Normal cross-section in another sheet, heat treated in furnace.

Picture 5: Photomicrograph of Alcan 24S sheet from 0.032 in. material heat treated for 30 min. period.



Picture 6: This is the same sheet as picture 5 after it had been held at heat-treat temperature for 120 min.



Curves show changes as delayed quench is extended.

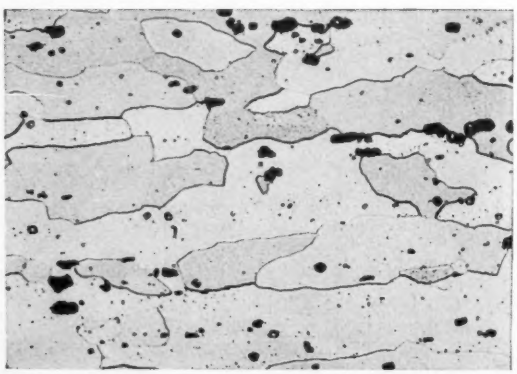
ward due to the difference in concentration. After prolonged heating the coating becomes an aluminum-copper alloy and its electrolytic protective value is reduced.

It should be borne in mind that in the case of certain wrought products, such as sheet, tubing and extrusions, supplied in the heat-treated condition, some reduction in mechanical properties is to be expected on reheat treatment, owing to the loss of the hardening effects of stretching and flattening.

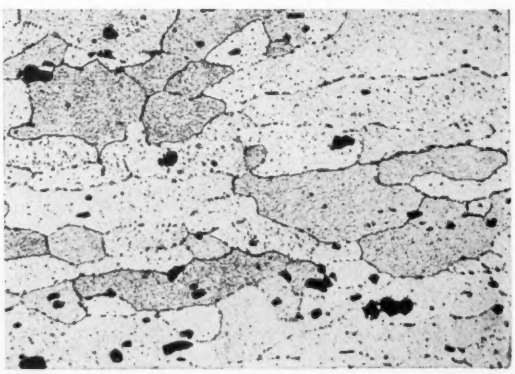
Delayed quenching is most critical in the copper alloys and very much less critical in Alcan 75S and in magnesium-silicide alloys such as Alcan 65S. The curves in the diagram show changes that may be expected in mechanical properties as the period of delayed quench is extended. Two photomicrographs (pictures 7 and 8) show test samples.

A difference in structure would be readily apparent with a delay of even 10 seconds, and there would be evidence, along the grain boundaries, of a number of small constituent particles not visible in the sharply outlined boundaries of the sample marked "Instantaneous."

In the photomicrographs for a delay of 120 seconds, "the string of pearls" at the grain boundaries is apparent. Excessive precipitation has occurred so that at this stage precipitated particles are becoming evident within the grains themselves. ★



Picture 7: Change in microstructure showing how no delay in quenching affects the corrosion resistance.



Picture 8: Photomicrograph of change in structure after 120 second delay shows "string of pearls."

The second backing plate on the assembly is placed to form the clad sandwich during manufacture at Lukens.

Clad steels resist wear and chemicals

If you bond two metals together, you put the good properties of both to use

SAUCEPANS TO SUBMARINES are using the little-known group of metal products known as "clad steels." Cladding has come into prominence only recently, although the bonding of one metal to another to take advantage of the properties of each is not new. Processes of this kind are recorded back to the 3rd century.

The first commercial plate of clad steel in North America was produced in 1930 as a joint effort of the Lukens Steel Company and the International Nickel Company.

The nickel clad steel plate was formed into a railroad tank car, with the nickel inside. The car is still used to haul iron-free caustic soda.

Today carbon and low-alloy steels are being clad with a variety of metals and alloys, including any of the several types of chromium and nickel stainless steels, the high-nickel alloys Inconel and Monel, copper, silver, nickel-silver and brass.

The successful production of clad steels involves the solution of several technical problems.

First an oxide film has to be prevented from forming on the cladding metal. Then, an economic method must be found to keep the alloy surface clean while it goes through the rolling process.

A parting compound must be found too, which will make possible the separation of two closely joined layers of cladding metal after rolling.

A clad plate is defined as a complete plate made up of two or more different metals permanently and integrally bonded over their entire surface. Lukens clad steels consist of a cladding of either nickel, stainless steel, Inconel, Monel or copper, completely bonded to either a carbon or low-alloy steel backing plate. The clad steels provide at low cost, corrosion resistance, abrasion resistance, and other benefits of more costly metals.

The economical practicability of using the clad steel process is evidenced in the number of large vessels, tanks, agitators, towers, heat exchangers as well as other operating and storage equipment that are made by this process.

Manufacture of clad steel, including stainless clad steel plate, begins with a careful cleaning of the surfaces to be bonded.

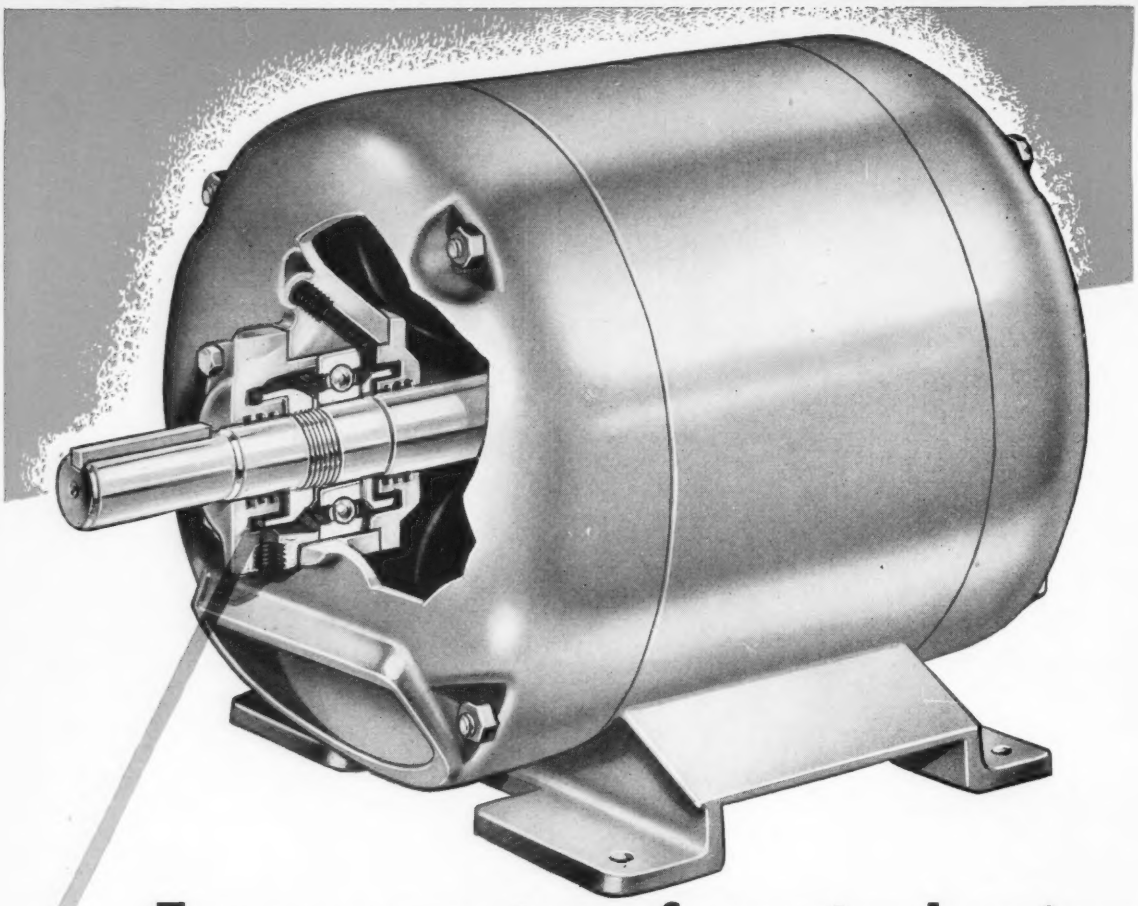
For clads of Monel, high-chromium alloys (the stainless types) and copper, the bonding surface of the high-alloy side is cleaned and nickel plated by an electrolytic process. In rolling, the nickel plating spreads to a thin, unbroken high-alloy layer which strengthens the bond and retards carbon migration.

After the components have been processed they are assembled into a pack or sandwich. The pack is then rolled on one of the company's large mills. Through the combination of heat and high pressure the thicknesses of the materials are reduced uniformly and an integral and permanent bond between the respective claddings and backing steels is formed. Then, after it is rolled the pack is sheared or flamecut.

The assembly is next separated into two clad steel plates, each of which consists of a steel backing with a layer of the clad metal permanently bonded to one surface. Because of the special properties of stainless steel, stainless-clad plates are heat treated after rolling to assure maximum corrosion resistance. The clad surfaces are brightened by immersion in an acid bath. Stainless-clad plates are passivated by immersion in acid. Finally after a holding bath in water and high pressure spraying, the plates get a hot water bath.

Clad steels are being used more and more in equipment for the chemical, petroleum, pulp and paper, paint, textile, and many other industries. Brew tanks, candy kettles, refining vessels, dam gates, giant coal chutes, penicillin equipment and home kitchen utensils are further examples of their use.

Wherever there is a danger of corrosion, contamination or abrasion, any need for resisting the attack of chemicals or wear, the clad steel process is helping to solve such design problems. ★



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Twisted contours

(Continued from page 47)

portion between the focal plane and the root of the blade is illuminated, a black image on a white background is obtained; but a white image on a black background is provided if the piece between the focal plane and the objective is illuminated. The illuminating device can be set to show the profile as a narrow line—which would be necessary if several sectional profiles were to be superimposed on one another.

Blades with high-polished surfaces are first coated with a thin layer of magnesium oxide less than 0.0004 in. thick. This strongly diffuses any light that is thrown onto it. If the surface of the blade is not polished, it is good enough for inspection purposes, to spray it with magnesium oxide powder.

The groups of lamps are arranged on a rotary mounting, the axis of which coincides with the optical axis of the objective. The rotary table is provided with radial grooves so that the lamps can be adjusted in the position required. As there are six light sources, it is always possible to create a highly luminous zone of uniform intensity round the section to be examined, whatever the form of the profile may be.

The blade itself is held on an L-shaped mounting in an adaptor made to suit the root-form of the blade. This mounting may be adjusted or swiveled in order to superimpose the projected blade image on the image of the master profile on the screen. For this reason, it is carried on vertical and horizontal slides having micrometer adjustment reading to 0.0001 in. In addition, a swiveling holder permits the blade to be rotated about its axis. Angular settings reading to 5 min (of arc) are obtained by a fine-adjustment vernier knob.

As it is necessary to inspect the blade at several predetermined positions along its length it must be possible to move the complete workholder unit quickly to the required settings. Ordinary longitudinal adjustment of the workholder is made by turning a handwheel on the front of the instrument, below the viewing screen. For repetition settings the workholding carriage can be quickly located in any required position by means of a notched detent bar on the side of the workholder.

Adjustable internal lighting is provided to illuminate the screen slightly and so make it easier to compare the image with the master profile. A black curtain, however, is necessary when viewing the screen, in order to exclude external lights. In future models, a red background illumination may be added which, when used with green glass reference plates, will give a black-overlap effect between the master image and projected profile, and so simplify inspection.

It is claimed that errors due to the projector and to the application of the coat of magnesium oxide do not exceed 0.002 in. at a magnification of x 10, or 0.0008 in. at x 20 magnification. With unpolished blades (sprayed with magnesium oxide powder) the corresponding figures are 0.0016 in. for x 10 magnification and 0.0006 in. for a magnification of x 20.

Two types of object lens can be fitted —one solid and the other annular. With the solid lens, sections up to 14 in. from the tip can be inspected when a x 10 magnification lens is used, or 7 in. from

the tip when the magnification is x 20. When sections situated further from the tip are to be inspected, an annular lens is fitted which allows the blade to pass through. There is a certain loss in the intensity of the projected image because of the absence of the central portion of the lens. However, this arrangement permits all sections of blade up to 27½ in. long to be examined.

Other optical devices are available to project sections of the blade that are in normally screened situations, such as the tip sections adjacent to a shroud. This result is achieved by reflecting the section required to the object lens by a mirror (see diagram). A light attachment is fitted to throw two bands of light spaced to suit the distance apart of the sections that are to be checked. Also, a mirror attachment is provided; this incorporates two mirrors (one above and the other below the blade) which can be closed on to the blade, or retracted.

Suppose that section (S) situated directly behind the shroud (E) is to be inspected first. The two mirrors (M) are closed on to the blade in such a manner that the fictitious image (S_1) which they give of section (S) lies in the focal plane of the objective (O). The rays diffused by the luminous belt around section (S) are reflected by the mirrors into the objective (O), which projects the image of section (S) on to the screen.

Then, by retracting the mirrors clear of the blades the second section (S_1), delineated by the second luminous belt, can be inspected by direct projection.

If it is desired to project two sections in rapid sequence a semi-transparent glass plate (L) is placed on each side of the blade, midway between the two stations to be inspected, S_1 and S_2. They are so positioned that the image of S_1 lies in the same plane as section S_2, that is, in the focal plane of the objective (O). The rays emitted by S_2 cross the glass plates (L) in the direction of the objective (O). The rays emitted by S_1 are reflected to the objective by the glass plates (L).

A physical limitation is necessary on the width of blade that can be accepted. For a magnification power of x 10, blades of 4 to 5 in. width can be inspected, although when the annular lens is fitted this figure is reduced.

A special Taylor-Hobson microscope has been developed for examining the leading and trailing edges of turbine blades. It employs the light-slit principle. A narrow band of light is projected obliquely round the edge of the blade to define the section, which is viewed obliquely through the microscope. The elements of the patented optical system are arranged to cancel out these obliquities and, as seen through the eye-piece of the microscope, the image is that of the normal cross-section of the blade. The field of view at the blade edge is of 0.18 in diameter and the shape of the blade edge is seen at a magnification of x 40. Errors of the order of 0.001 in. are therefore readily caught.

The observed shape of the blade edge is compared directly with a master profile, 20 times actual size, through the eyepiece of the microscope at a magnification of x 2, giving a x 40 magnification in all, to equal that of the blade-profile image. The master profiles can be prepared in the drawing office and a direct x 20 drawing will often be adequate. For the greatest accuracy, however, and where it is necessary to inspect very small radii, it is preferable to lay out the master profile to a larger scale and to reduce it photographically.

The brightness of the drawing-image relative to the blade image can be adjusted and two screws permit the blade image to be quickly orientated with that of the drawing. ★

Quotes

Points from current papers and speeches

A DESIGN FOR Non-Sticking plug and ring gauges and locators is dealt with by **Doyle, Better and Chao,** in University of Illinois Bulletin No. 433.

It is well known that if a plug is inserted in a close-fitting hole, the plug has a tendency to stick or jam if it is not truly in line with the hole when it enters. When the plug or ring is manipulated by hand, it is difficult to align the two closely enough to prevent initial sticking. The plug and ring must then be realigned, and often the attempt at realignment results in sticking in another position. The trial may have to be repeated several times until the two pieces go together. A similar tendency to stick at the end of the hole also occurs when the plug is removed. The result is normally a loss of time whenever a plug is inserted in or removed from a close-fitting hole.

Certain empirical means of alleviating or eliminating this sticking tendency have been used for a long time. Some results have been obtained from grinding a short pilot or lead diameter on the end of the plug, or better, from an aligning groove near the end of the plug.

The applications of these ideas have been largely by "rule of thumb." In the literature on the subject, instructions for the design of patented parts have commonly specified that the actual proportions be obtained by trial and error in each case.

Some empirical designs have been offered for devices like those described. A few formulae, without derivations, have been given in recent years, but otherwise nothing has been found that constitutes a logical basis for design.

This investigation was undertaken to ascertain the conditions that cause plugs to stick and, from analysis of the conditions, to determine the limiting dimensions for nonsticking devices.

It was not confined to the common nonsticking devices already in use and just described, but encompasses some related devices and also reveals the nonsticking possibilities of others.

• • •

A METHOD of slicing and dicing germanium and silicon crystals, was given by **T. H. Kinman** and **C. Hayward,** in BTH activities.

They state that there is no method at present of producing germanium or silicon to the exact size, shape or quality required for making rectifiers, transistors and the like. The thin wafers or pellets used in the semi-conductor devices must all be cut from the solid ingot, and this usually results in a waste of material.

The value of a single crystal when refined, processed and drawn is very much greater than the raw material. Germanium, for example, costs over 20c a gram to produce in the quality required for making high power rectifiers, and silicon at present is even more expensive. As the cost of recovering the waste metal from the cutting sludge is prohibited, it is necessary to economize in cutting, especially when handling large quantities for production.

The new method is based on a very old practice believed to have been used in quarries for cutting slabs of marble with rope saws, fine wet sand being used as the abrasive. The same principle has also been used to cut piezo-electric crystals for telephonic equipment. These water soluble crystals were cut into thin wafers simply by friction against a wet cotton thread without causing this friable material to disintegrate.

For cutting harder substances, it was necessary to use a wire instead of a thread. Tungsten was found to be the most suitable material for the wire, because it is hard, ductile and available in the thin diameters required.

From simple models, using single wires, machines with multiple wires and other refinements have been made, suitable for slicing and dicing crystals into many sizes and shapes for making a wide range of semi-conductor devices, thus keeping more economically with the previous methods.

• • •

FIGHTING THE Hot Box was the title of an article in the **Neoprene Notebook.** Normally, journal boxes are packed with cotton waste which holds oil and lubricates the bearings. Too often some of this waste is carried up between the bearing and the axle. This is called waste grab and is the major cause of hot boxes.

One answer to this problem is a neoprene sponge journal box lubricator that does away with cotton waste entirely.

A highly absorbent felt wick pad is fitted to the top surface of the sponge neoprene like a saddle. In operation this pad always contacts the underside of the journal.

Six wick ends pass through slots in the sponge down into a rectangular recess formed by the underside of the sponge pad. The recess provides an entirely enclosed reservoir, holding two pints of oil, at the bottom of the journal box. Another two pints are absorbed in the sponge and in the felt, so that a total of four pints of oil are available for lubrication.

The felt wicks oil to the journal. But the lubricator does not depend on the felt alone to deliver oil. The resilient sponge acts as a pump to ensure adequate lubrication. There are three holes in the pad directly under the wick. Each vertical movement of the journal or journal box compresses the pad and forces oil upward through the holes.

• • •

DETAILS OF A deep-freeze treatment at —120F were given in a recent issue of the Alcan Ingot.

The treatment is used by Canadian Westinghouse Co. Ltd. on castings of Alcan 135-T22 and 350-W. These are first heat treated and then put in the deep-freeze for four hours before machining.

Instead of the three-holed machining cycle that was used before the deep-freeze method was introduced, they are set up at once, machined to 0.010 or 0.015 in. and then finished to specification.

• • •

AN SAE PAPER, The Differential Gas Turbine, was given recently by **David W. Hutchinson.** The information he gave was the result of research directed toward better performance of gas turbine power plants by improving the internal relationships between the compressor and turbine components. In most cases, the benefit so gained will add to the benefit gained by improving the performance of the components themselves.

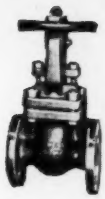
The use of a differential as an interconnection between the compressor, turbine and output shafts establishes entirely new equations of torque and speed. These new relationships enable the differential gas turbine to maintain higher component efficiencies and better thermal efficiency than conventional power plants while operating over the wide torque and speed ranges required in transportation applications.

The differential gas turbine, therefore, offers many advantages including better part load fuel economy, quicker acceleration, lower idling fuel consumption and a broader operating range.

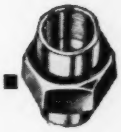
Information was given in three parts A. A discussion of the fundamental differences between differential and conventional power plants. B. Comparison of the over-all performance of the basic differential and conventional two-turbine power plants. C. Two-turbine differential gas turbines for transportation.

ALUMINUM . . . NICKEL ALLOYS . . . STAINLESS STEELS

VALVES...



FITTINGS...



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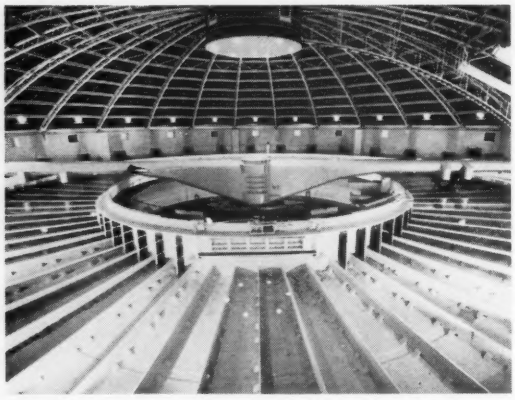
Design news in pictures

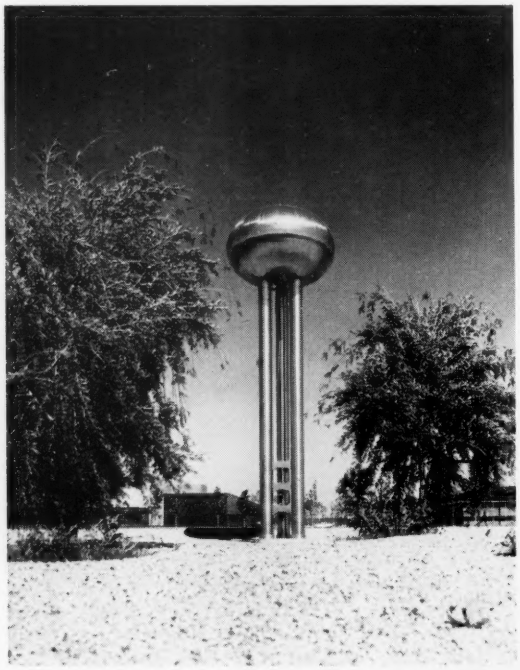
Some modern designs making news today



Resembling empty seats at an arena this annular channel with 60-ton rotating beam, mid-photo, will be used by new Admiralty Research Laboratory in Middlesex, England. It can study underwater behavior of models.

Catch your breath, but this log-lifter made by R. G. Le Tourneau, Inc. is lifting 20 tons of iron-wood logs in the above photo. Designed by company it is destined for lumber mills, logging camps, across Canada, U. S.

Device for handling radioactive materials in nuclear research, master slave manipulator, was shown at "Atoms in Action" exhibit of AMF Atomics Inc. at Nuclear Congress and Atomic Exposition in Cleveland.



Unique structure, this 138-ft. stainless steel-clad water tower holds 250,000 gals. Three column supports are also stainless steel-clad to eliminate periodic painting which is normally necessitated because of corrosion.

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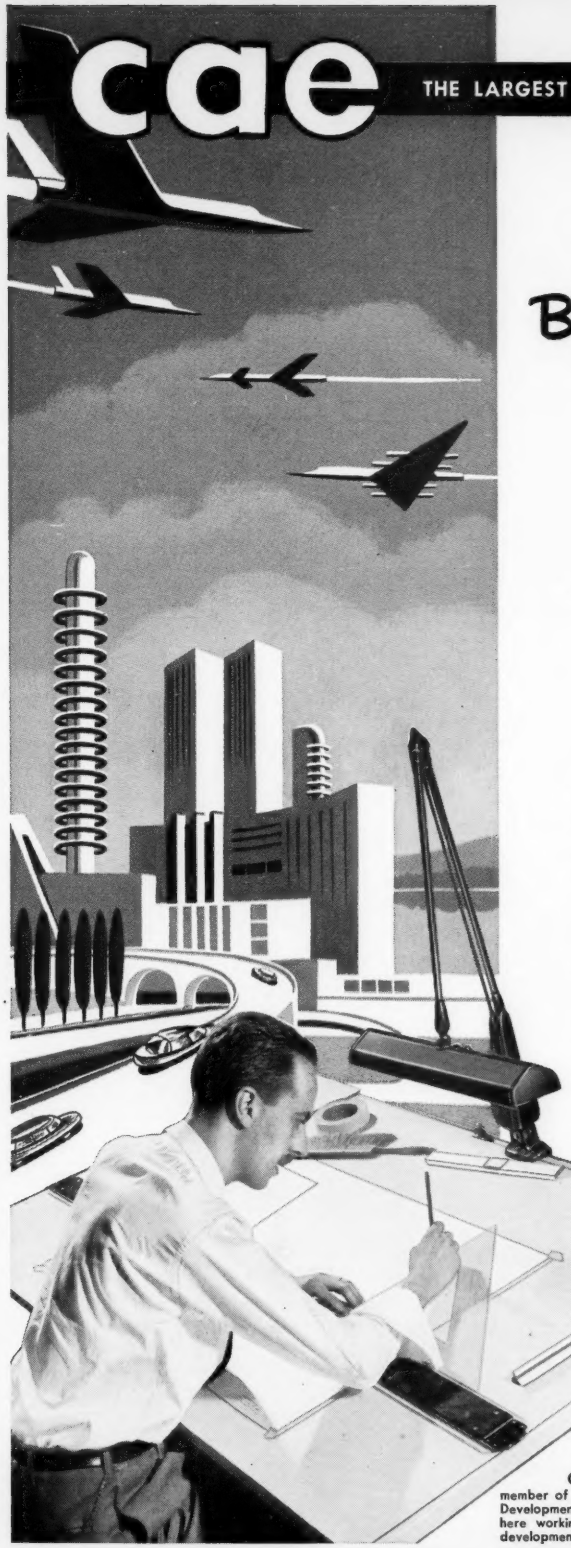

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Charles Beaudry
member of CAE's Design and Development Staff, is pictured here working on an original development project.

Scientists and engineers planning a future in the dynamic era which lies ahead will find CAE a vitally 'live' organization where ideas are welcomed . . . and inspired! A place where vivid imaginations, driving ambitions and special abilities help to bring Canada's future a little closer . . . a little faster.

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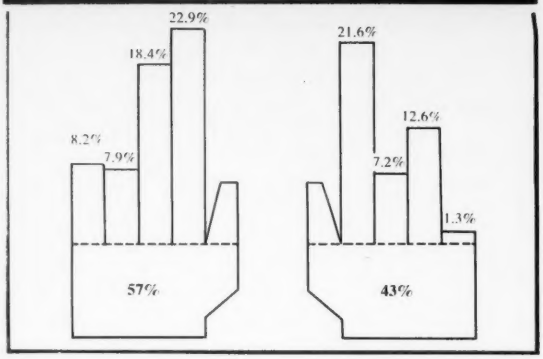


Today weight is on typists wrong hand, wrong fingers.

Is it time to correct an 80

A NEW TYPEWRITER keyboard! What is wrong with the old one ask writers, stenographers and everyone else who uses a typewriter. And the proponents of a new keyboard arrangement answer that the "old" keyboard is just that—old, designed in fact by the fifty-second man known to invent a typewriter, Christopher Latham Sholes of Milwaukee in 1873.

Although his machine had many similar predecessors* both in the United States and Europe, Scholes' typewriter was the first to be manufactured.

A successful middle-aged businessman, Sholes at 48 had been in turn a newspaperman, printer and politician. And he had been equally eminent in each business. Also he was an inventor—a practical tinkerer—in his spare time. In these off-hours he designed his machine.

The Remington Arms Co. manufactured and marketed his typewriter, a crude product judging by modern standards.

If successive letters were located close together the machine would jam. To get away from this hazard, Sholes designed his keyboard so that the letters used most frequently in words were farthest apart on the type arm that struck the page.

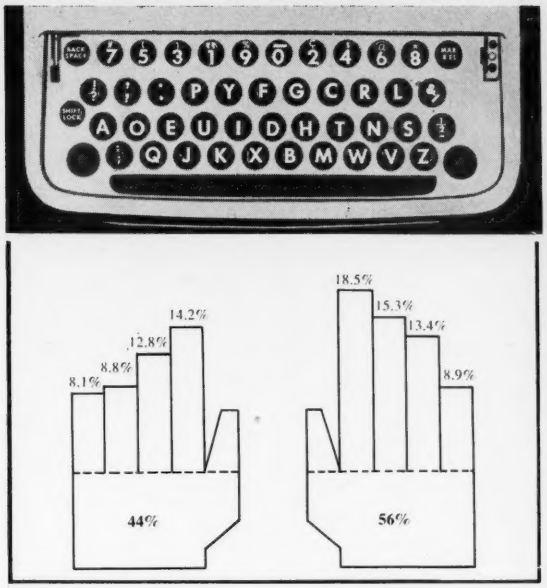
August Dvorak, a former director of research at the University of Washington and director of the Carnegie Foundation Investigation in Typewriting says the keyboard was a bad arrangement.

"It is possible to make at random dozens of typewriter keyboards which are as good or better than the Sholes Universal or Standard Keyboard," he emphasizes.

"If the letters and characters in the lower three rows of keys on the Sholes keyboard are drawn from a hat and placed by pure chance, arrangements are often secured on which the total hand and finger loads are more equitably divided with better row-load distribution, fewer awkwardly stroked letter-sequences than on the (old) keyboard."

Since the typewriter was only expected to be operat-

*An English engineer, Henry Mill, is credited with thinking out the basic principles of the typewriter. On January 7, 1714, Queen Anne granted him "Royal Letters Patent" which gave engineer Mill exclusive rights for the next 14 years to make what is described as "an artificial machine . . . for the impressing or transcribing of letters singly or progressively . . . as in writing . . ."



Agreed above keyboard is better, who makes next move?

year old mistake in design?

ed at a speed equal to that of handwriting, it was supposed that typists would hunt and peck with the first finger of each hand. The concept of touch typing and typewriting speed were not imagined when Sholes' keyboard was first adopted. Yet, with one little change it is the standard arrangement now—83 years later.

The Dvorak system is not the only keyboard arrangement under consideration for the inevitable change. Some systems that have been proposed claim improvements over his keyboard. However, both the Dvorak and other arrangements put the greater percentage of work on the stronger right hand and double the amount of typing done on the guide or home row.

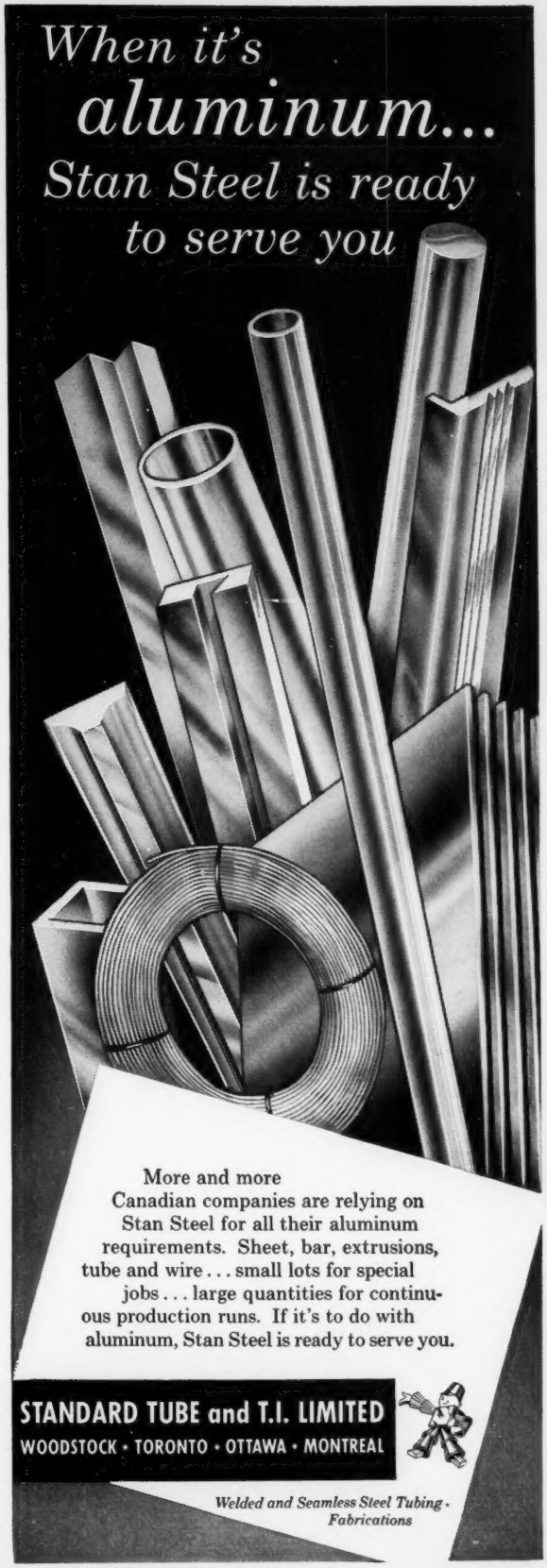
Other improvements of the proposed simplified keyboards permit up to 30 times as many words to be typed exclusively on the guide row. The number of words that have to be typed exclusively by one hand is reduced from 3,900 to 61. Left hand words alone at present amount to 3,500 of the near 4,000 total.

"The Dvorak keyboard was first proposed in 1940. On a 46-week trial by six girls from different companies the greatest gain in production was noted as 21 per cent," says the American Management Association.

In tests conducted by the U. S. Navy in 1943-44, the results indicated a 74 per cent gain in net words per minute for typists trained in the Dvorak system. Retraining typists on the standard keyboard gave a 43 per cent gain in net words per minute.

"Retraining is the major problem. In typists who first resist conversion to the simplified system, there is a later tendency to become enthusiastic about the arrangement. They show an increase in speed, reduction in errors, and less fatigue," observes the Nat. Office Management Association.

So the outdated keyboard developed originally to conform with the mechanical limitations of the typewriter's manufacture appears to be in for a change. Today, the design of the modern typewriter allows any arrangement of the keyboard that will be of benefit to the typist. The researchers are convinced that a new system must come: The typists are skeptical. What do you think? ★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TWO TUBE cap designs, one for high voltage arc-over and corona suppression and the other for suppression of corona and voltage insulation at high altitude and high temperatures are being marketed by the **Alden Products Company.** Both of these new tube cap connector designs use a new production technique by the company. The contact, lead, and corona shield assembly is molded as an integral insert into the insulating body, completely bonding the wire and connector insulation into a sealed unit.

One cap is called the skirted corona shielded tube cap, designed for the RCA voltage regulator tube 6BK4. It is used in the RCA color TV circuit where it has passed the test for suppression of corona at 30 kv. It has its corona shield, contact and lead assembly molded into nylon insulation and provides a long integral skirt that fits down over the top of the tube and thereby prevents

Alden Products' new tube caps

flashover of the high voltage to surrounding grounded chassis parts. It can be used in any circuits where the 6BK4 is used and will also fit on glass tubes of like dimensions and a ⅜-in. cap.

The other cap is the insulated corona shielding tube cap with in-line resistor. This connector has the corona shield, contact, a resistor and lead molded as an insert into an insulation body of fluorothene. The design accommodates anything up to a 2-watt resistor. Values can be specified for loading the tube or whatever is needed to reduce parasitic oscillations. Since the resistor is completely sealed into the insulation, there is no wire hole so a serious high altitude arc-over problem has been eliminated. (200)

CONSTRUCTION HAS been simplified and friction reduced while maintaining required pressures over a wide temperature range in Stewart-Warner's new Alemite Farm Gun by using "Quad Rings," a four-lipped hydraulic seal developed by **Minnesota Rubber & Gasket Co.**

Their use made construction easier by eliminating several parts previously required in guns of this type. In addition, contoured lips of the seal absorbed the variations in standard tubing, giving an effective seal with considerably less squeeze than an O-ring, therefore producing less friction and giving longer life.

Installed as a follower ring after laboratory tests it proved to have far less friction than any other type of seal. And it gave a better seal and delivered the grease to the nozzle with less effort and more pressure than anything used previously.

Another such ring used in the pump loading equipment, was also effective in sealing the stem against leakage, and preventing the gun from becoming dirty and greasy.

The rings do not have parting lines on sealing surafces. Torque leakage at low pressure differentials and spiral twist failures or rolling with pulsating pressures are also eliminated. (201)

• • •

A NEW Safe-T-Beam headlight for heavy-duty trucks and buses operating under conditions of high vibration has been produced by the lamp division of **Canadian Westinghouse Company.**

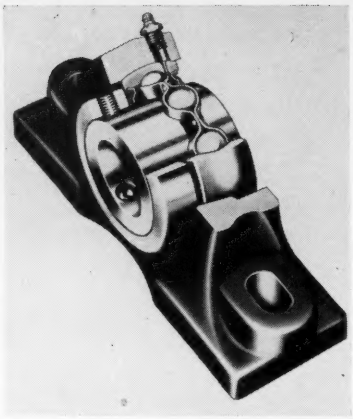
The new unit is designed for 12-volt electrical systems and has the performance features of Safe-T-Beam passenger vehicle lamps.

Both filaments of the lamp are shielded for greater penetration in rain, snow and fog, on both driving and passing beams. The passing beam provides effective illumination up to 80 ft farther than previous lamp types. The filament support is designed to offset the effect of heavy vibration. (202)

• • •

A NEW pillow block has been developed by the **Dodge Manufacturing Corp.** to meet the demand for a high-quality medium-duty bearing at moderate cost.

An exceptionally rugged semisteel outer housing offers a streamlined appearance as well as greater strength. Full self-alignment is provided by the



A cheaper medium duty bearing.

spherical outer race of the ball bearing inner unit which fits accurately into the spherical seat in the semisteel housing.

It is effectively sealed to retain lubricant and exclude dust and dirt. Metal backed synthetic seals are mechanically anchored and cannot be blown under grease gun pressure. A locking pin prevents rotation of the outer bearing race while allowing full self-alignment.

The bearing is securely locked to the shaft by means of two set screws through the collar at 120 deg. (203)

• • •

A GEAR REDUCER with infinitely variable speed from true zero to the maximum of the unit has been engineered by **Revco Inc.** by building a gearhead into the output side of a fractional horsepower Zero-Max Variable Speed Transmission.

The infinitely variable speed is obtained through the transmission unit which has a range from true zero to ¼ the input speed. Because the gearhead input shaft is integral with the Zero-Max output shaft the speed of the gearhead output is infinitely variable. Speeds can be changed instantly while the unit is running or stopped simply by moving the speed control lever on the Zero-Max unit. It is said that the unit develops constant torque with exceptionally accurate speed control.

Gear reductions of 2, 3, 4 and 5 to 1 that develop 20 to 100 in. lb. of torque are possible. Input and output shafts are parallel and the output shaft rotates counter clockwise on standard models. Clockwise operation is also available. Twenty-six models and types with various torque ratings and a variety of ranges of stepless speeds away from zero are available.

The output shaft is ½ in. diameter with cartridge-type oil seals. The entire unit, transmission and gearhead, runs in oil and may be mounted anywhere. (204)

• Cleveland OOD double reduction type speed reducer installed on a Microgrinder. Photo courtesy Curtin-Herbert Co., Inc., Gloversville, N. Y.

CLEVELAND-driven grinder sands to .001"

THIS highly accurate Microgrinder is used to sand wide webbed material to extremely close tolerances. In some production jobs it sands to plus or minus .0005". Such precision work demands dependable, uniform power transmission—and a Cleveland double reduction worm gear speed reducer has a vital part of the job.

The abrasive-wrapped cylinder is driven by a 20 hp motor. A belt drive runs from the cylinder to the Cleveland speed reducer, and the back-up roll is chain driven from the reducer. The extended intermediate shaft drives a ball bearing eccentric which oscillates the cylinder.

Clevelands fit perfectly into complex power transmission jobs. They're compact—right angle construction of a worm gear drive saves space. High shock load resistance and efficient performance are inherent. Parts are reduced to a minimum, reducing maintenance. Torque flow is smooth and uninterrupted. The case-hardened steel worm and nickel-bronze gear actually improve with use.

Wherever you have a power transmission need or problem, simple or complex, find out how a Cleveland speed reducer can handle it dependably and economically. Send for Catalog 400 today. Peacock Brothers Limited, P. O. Box 1040, Montreal 3, Que. Branch offices in Sydney, Toronto, Sudbury, Winnipeg, Edmonton, Calgary and Vancouver.

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File

New booklets and books written for you

A NEW PUBLICATION, ORGANIC Chlorine Compounds, has just been produced by **Carbide Chemicals Co.,** a Division of Union Carbide Canada Limited.

The application of eighteen products, their solvent properties, and their proper handling and storage are covered in the publication. It includes important data on physical properties, specifications and test methods, shipping information, and constant boiling mixtures. Fourteen charts contain useful property data.

Chlorinated compounds are excellent solvents for hydrocarbons, alkaloids, and synthetic rubber. They are used in the manufacture of pharmaceuticals, adhesives, plasticizers, surfactants, lubricants, emulsion and foam breakers, resins, and other useful compounds. They are also used as fumigants, freezing-point and solubility depressants, and cross-linking and hardening agents. (205)

• • •

A NEW BULLETIN just published by **National Vulcanized Fibre Co.,** is called Engineering Materials for Modern Industry. It reports the properties, grades and uses of vulcanized and phenolite plastic.

Case studies, illustrated by more than 45 photographs, match physical properties (impact resistance, dielectric strength, arc resistance, durability, light weight, flexibility, temperature and corrosion resistance, compressive and tensile strength) to typical uses (transformer coils, circuit breakers, rail joint insulation, gear blanks, athletic safety equipment, backing for abrasive discs, sample cases, chrome plating barrels, printed circuits) for both of these materials.

Tables list the general properties of the several grades of the Company's vulcanized fibre (including commercial fibre, bone fibre, Peerless insulation) and the many grades of National's laminated plastic including such base materials as paper, cotton fabric, asbestos, fibre glass and nylon fabric. (206)

• • •

ENGINEERS IN THE automotive, aviation, military and general industrial fields designing in aluminum, magnesium, plastics, and wood as well as iron and steel will find a new design manual and catalogue on wire thread inserts made by the **Heli-Coil Corporation** highly useful.

The new catalogue presents complete design data with thirteen line drawings, eight photographs and ten multi-page tables.

Stainless steel wire thread inserts have been specified for many years by design engineers to obtain strong, permanent stainless steel threads in the light metals, plastics, wood, iron and steel. Because of their negligible wall thicknesses, inserts can easily be incorporated in existing designs.

Separate sections in the bulletin are given to automotive and aviation spark plug threads and pipe threads. (207)

• • •

AN ILLUSTRATED catalogue listing properties and applications of a wide variety of adhesives, coatings and sealers is available from adhesives and coatings division, **Minnesota Mining and Manufacturing Co.**

Applications for the adhesives, coatings and sealers in industry are listed in easily understood tables in the catalogue. (208)

• • •

PRELIMINARY DESIGN data for the Flex'ator the only compression spring to exert the same force at any deflection, is presented in an engineering bulletin published by the **Hunter Spring Co.**

It describes the characteristics and properties of the spring, materials, types of ends, methods of mounting, design formulas, and design standards.

Four tabular form design charts, each representing a different fatigue life requirement, or stress level, are included along with specification instructions. (209)

• • •

A NEW TYPE of distribution transformer has been developed by the **English Electric Co. of Canada Ltd.** that combines the established stable and uniform performance characteristics of the familiar stacked core transformer. There is a 43% reduction in weight and a like reduction in bulk, says a brochure.

The use of Silicon rich, high-grade, oriented steel, improved by specially adapted annealing procedure. (210)

• • •

IN THE CURRENT issue of "Rubber Developments" published by the **National Rubber Bureau** there is a thorough review of ebonite, a vital industrial material, describing in full its chemical, thermal, mechanical and electrical properties. It also covers sheet, rod and tube and moulding applications of ebonite which was first developed as a substitute for ebony, and was probably known as early as 1831.

In later years, its hard, corrosion-resistant qualities have won their way into a wide range of industrial uses. It is considered one of rubber's answers to plastics. (211)

• • •

Book Department

Engineering Metallurgy

A KNOWLEDGE of material properties is absolutely essential if the design engineer is to make the best use of material in a given set of circumstances.

In this book, Engineering Metallurgy by **Dr. E. M. H. Lips,** the subject is treated from the point of view of the practical engineer, the data being presented so that the information can easily be found.

The book is divided into seven parts, the first of which deals with the mechancial properties of metals and alloys—hardness, the stress-strain diagram, impact, fatigue and creep.

After a short section on corrosion and a longer one on the phase diagrams (and metallography) of the iron-cementite and iron-graphite systems, there is an important chapter on the alloys of iron with carbon and other metals. This is divided into wrought alloys and cast alloys.

Non-ferrous metals and alloys—copper, aluminum and magnesium—come next and are followed by two chapters on heat treatment and the working and joining of metals.

The design engineer should find this book useful because it is well produced and the text and diagrams are easy on the eye.

Some criticism might be leveled, however, at the notation used. For instance, S is used, not A, for cross-sectional area, and P, not f, for stress, but no doubt this will not affect the average engineer unduly because he is constantly running into the problem and will continue to do so until there is a greater degree of standardization of nomenclature.

The book is distributed in Canada by Burns and MacEachern and sells at $7.00.

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Measuring noise

(Continued from page 45)

measurements are relatively simple, although it is very important to remember that a single over-all sound level measurement does not provide sufficient information for the full analysis of complex sounds. Where a detailed investigation of the relative amplitude of the component frequencies is required, the use of a Sound Analyzer is recommended.

When measuring fluctuating sounds, sound level measurement should normally be carried out with the "meter" switch set to fast position (electrically undamped). In this position the meter response simulates that of the human ear. For sounds which are not constant in level, an average reading should be taken if the fluctuation is less than 6 db. If the fluctuation is greater than 6 db, a value of 3 db below the maximum is more representative. Should this fluctuation be rapid and variable it may be advantageous to set the "meter" switch to slow position (electrically damped) where, due to the long time constant, an average reading will be obtained.

The distance between the microphone and the sound source will of course influence the reading. It is convenient to measure the noise produced by such sources as heavy machinery, domestic appliances or office equipment at a standard distance of, say, three feet from the nearest major surface. Transformers and some small rotating mechanisms may render a much smaller distance, for example one foot or six inches, desirable.

Whilst making the measurements, the observer may well form an acoustic reflector and thus modify the sound level response by his position relative to the microphone. If the sound is coming mainly from one direction, the instrument should be held so that the sound passes across the instrument from one side, i.e., the operator should avoid standing in line with the microphone and main sound source. At frequencies above 1,000 c/s where the wavelength becomes comparable with the size of the equipment case, it may be necessary to remove the microphone from the instrument and use an extension cable in order to overcome any standing wave effects.

The sound level measurement should normally be made under conditions where the background level of noise is negligible, for example when the background level is 10 db or more below the measured level. When the background noise is less than 10 db below the required level and is reasonably constant, a cor-

(Continued on page 72)

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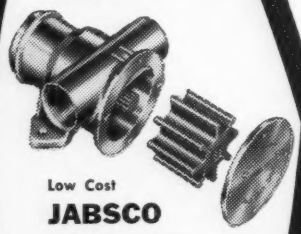

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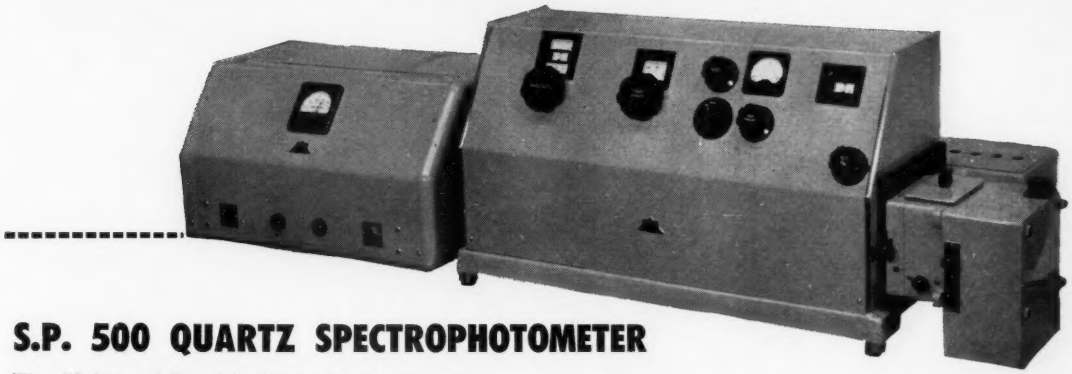

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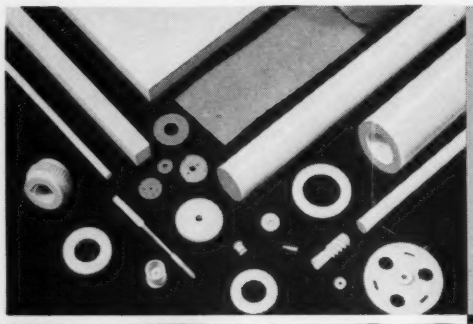

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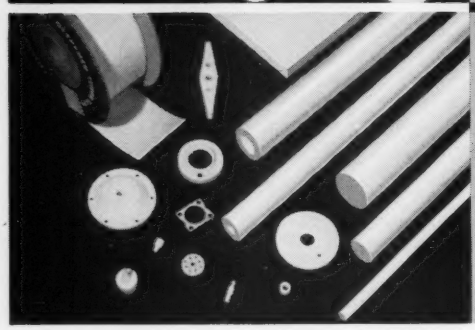

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Letters

Readers' viewpoints . . .

● Thank you for your letter and the wonderful issue (DESIGN ENGINEERING, February) carrying the glass story. I was particularly impressed by the cover and the photo presentation in the story—both done extremely well.

I am sending the single copy you sent me around to our advertising and engineering departments. Also a memo asking them about reprints of the article. I shall let you know immediately when I hear from them.

For our own use, we would appreciate four copies of the magazine and two sets of tear sheets for our files, if these can be conveniently come by. Would you bill this office directly for them.

Again, I think you did a superb job on the article. We down here in Corning are mighty impressed by you up there in Toronto.

ROBERT G. GULIAN
Corning, N.Y. Corning Glass Works

If reader response is anything to go by (and it is) people up here in Toronto are no less impressed by you down there in New York.—Ed.

● One of our design engineers is very much interested in the article, "Glass is what you want to make it" (DESIGN ENGINEERING, February).

We would not like to disclose the proposed use at the present time, but would ask you to give us further information if possible.

We would like a copy of the table mentioned on page 27, but apparently not published in the article.

We would also like to have the address of the author, Mr. John G. Lanning, so that we might communicate directly with him regarding further information on a specific type of glass.

Would you please let us have the answers to these questions at your early convenience.

St. Catharines A. M. JOHNSTON
McKinnon Industries Ltd.

The table was published—on page 28. It just happened to be a table without figures on it. But reader Johnston has a point. Can you call brief "optional reading" a table without tabulating it? If not, what alternative is there? DESIGN ENGINEERING is still trying to think of one.—Ed.

● Our principals, Spillingberg, Hamburg, have drawn our attention to a

paper on the special feature of the Spilling Steam Motor, written by your German Correspondent, Mr. Robert Gerwin, (DESIGN ENGINEERING, October).

We would appreciate very much to have you forward several prints of this paper or copies of the issues for our records together with your amount for same.

OTTO SCHULZE-SCHWANEBRUGGE
Montreal J. O. W. Lence Co.

● It is with great interest that I have noted the article on Indium Cells in your November issue. Would you kindly tell me where more information can be obtained.

The writer has been very pleased with DESIGN ENGINEERING since its first issue.
Comben (Ont.) V. M. TROJEC

● In your April issue of Design Engineering appeared an article "What is your Isocyanates I.Q.?" by Frank Chatterton.

May we have your permission to reproduce a condensed version of this article in a future edition of "Mechanix Digest."

"Mechanix Digest" is the house organ of Joseph Robb & Co. and is mailed free to some 6,000 engineers and other individuals across the country.

NORMAN CHAPPELL
Montreal McConnell Eastman

Permission is very happily granted.—ED.

● I am interested in the ultrasonic emulsifier (DESIGN ENGINEERING, October). Please forward any information you have available, including the manufacturer of the sonic head and, if possible, a mailing address for Mr. F. Rose, author of the article.

R. B. DONALDSON
Vancouver Canada Roof Products

● I am endeavoring to locate information on a simple electronic circuit that might be added to an amplifier to vary the degree of attenuation of certain audio frequencies.

To give an example, if a note is struck on a percussion instrument and that note with normal damping has a natural decay period of ½ second, I would like to extend this period to two or three seconds without altering the characteristic timbre of the note.

The circuit should be able to perform this function for several groups of notes struck simultaneously.

Any help that you are able to give me in this instance will be very much appreciated.
Kemano JOHN D. WHILEY

The information is being sent.—ED.

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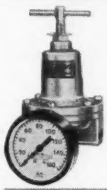

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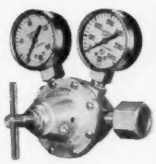

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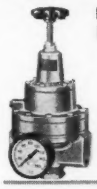

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For primary stage pressure regulation. Reduce line pressures up to 250 psi to desired working pressure up to 50 psi. ½", ¾", 1". Series 2E.

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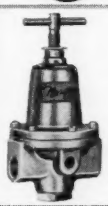

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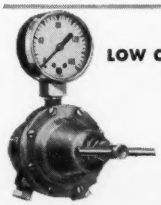

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Patents

Some new ideas win protection in Canada

A CONCAVE FILE of unusual construction is covered by Canadian Patent 519,491 issued December 13, 1955 to The Nolvex File Company, of Cleveland, Ohio. Naming Edward A. Noll of Bay Village, Ohio, as the inventor, the patent describes a file having a concave surface of transverse curvature throughout its length with its surface divided into two working faces, each about half its length. In each face, the teeth extend in parallel curves across the body with the convex sides of the curves toward the end of the body. The cutting edge of each tooth is on the outer side of the curve, and the teeth along the lateral edges of the file are chamfered.

• • •

THE PROBLEM of overheated brakes in today's high-powered cars is the subject of General Motors Corporation Canadian Patent 518,980, issued November 29, 1955. Invented by Charles A. Chayne, of Bloomfield Township, Michigan, the invention features a brake lining formed by spaced segments secured to the brake shoes, so that air can be blown through the spaces between the segments and thus guided across the interior surface of the brake drum. The air flow is then reversed and guided across the outer surface of the brake drum.

• • •

CORROSION OF METAL by the atmosphere is said to be inhibited by a composition covered by Canadian Patent 519,408 issued December 13, 1955 to Daubert Chemical Company of Chicago. The inventors are Edward J. Schwoegler and Clemens A. Hutter of Chicago. The composition operates by the emission of vapor to provide a barrier to the corrosion of the metal surfaces. It may be applied by covering the metal with paper impregnated with the composition. The composition contains sodium nitrite mixed with from a twentieth to 20 times as much urea.

• • •

UNDESIRABLE SWELLING in mouldings made by pressing and sintering iron powder with copper powder in a hydrogen atmosphere, is said to be counteracted by a method covered by Canadian Patent 516,539 issued September 13, 1955 to the Swedish firm of Hoganas-Billesholms Aktiebolag. According to the patent, the method also increases the tensile strength of the moulding. It consists of mixing the powdered metals with less than 3% of a powder containing metallic tungsten in the form of an alloy or containing a powdered tungsten compound. Tungsten oxide or wolframite are suitable compounds. Small quantities of chromium may also be added to increase the effect.

• • •

AN ELECTRIC-MAGNETIC brake that operates only when the current to the magnet is cut off, is covered by Canadian Patent 517,060 issued October 4, 1955.

Invented by Robert G. LeTourneau of Longview, Texas, it has friction plates on the stator member that engage others on the rotor member, and an electromagnetic coil on the stator that holds the friction members apart until the brake is to be applied. When the current is cut off, the friction plates are pushed together by springs acting on a pressure plate in the new invention.

• • •

A NEW SMALL-SIZE boiler construction for heating houses and apartments, said to combine compactness and low cost with high efficiency, is covered by Canadian Patent 516,070.

A novel flue construction is responsible for the high performance, according to the patent, which was issued on August 30, 1955 to Atlantic Development Company, Inc., Frankfort, New York. The flues are flattened, open-ended tubes with corrugated sides, the corrugations on opposite sides being in phase to as to produce a generally sinusoidal, tortuous path for the flue gases. This results in efficient heat exchange between the hot gases and the water in the boiler, without requiring baffles.

The inventor: Hother H. Anderson of Yonkers, New York State.

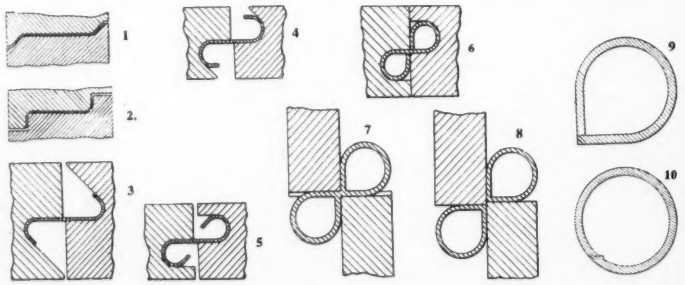
• • •

A LAMINATED plastic material for machine belting is the subject of Canadian Patent 520,957 issued on Jan. 24, 1956 to Harry Brammer of Leeds, England, the inventor. The belting material made by extruding flexible plastic strip and cutting short lengthwise slits in it. The belt is then expanded crosswise to open all the slits, and both sides of the spread strip are coated with a vulcanizeable composition. The coating is then forced into the open slits by pressure, and the coating material is vulcanized, uniting the coating on opposite sides of strip through open slits.

• • •

A METHOD OF manufacturing tubing from strip metal stock, that is said to lower manufacturing costs and deliver better tubing has been patented by Lundy Tubing Company of Detroit, Michigan, which obtained Canadian Patent 517,096 on October 4, 1955.

Invented by Arthur M. Wallace of Birmingham, Michigan, the patented method forms a single strip into two tubes with one pass through a tube forming apparatus. Only one welding operation is required. As shown in the drawing, the interfaces that are to be weld-united are brought together at right angles so that they can be held for welding without distortion. The weld is made through the full area of the interfaces with a minimum of burr or projecting fins. The drawing shows the various stages as the strip stock passes through six pairs of forming rolls prior to welding.



Drawing shows consecutive stages of tube manufacture.

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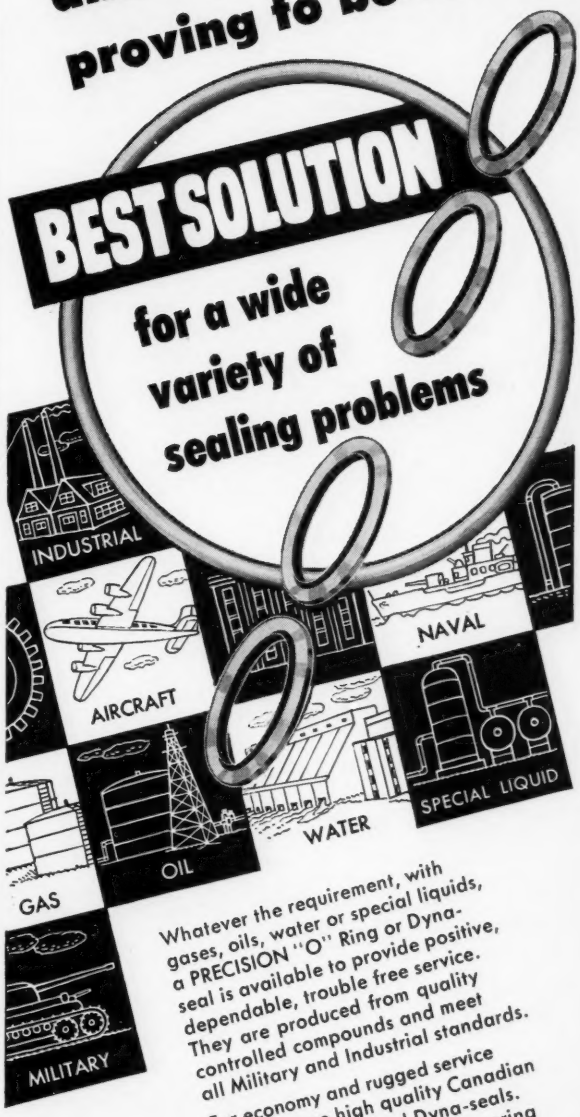

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Measuring noise

(Continued from page 45)

rection may be employed using the curve shown in graph 1.

When a source of sound is located in the open away from any reflecting objects, the sound pressure level decreases by 6 decibels each time the distance from the source is doubled. However, in an enclosed space, multiple reflections can arise which alter the distribution of the sound pressure. For example, standing waves may be present due to interference between the direct and reflected waves and thus the resultant will rise and fall as the microphone is moved away from the source. If it is impossible to avoid standing wave effects, the average of adjacent maximum and minimum indications may be taken.

Typical applications of sound level meters are in industrial plants, theatres, concert halls, cinemas, broadcasting studios and offices, by measuring the sound level and deciding whether corrective action is necessary.

Another application is in checking the noise emanating from the moving parts of products before they leave factory. This consists of the routine checking of motors, refrigerator units, air conditioners, fans, floor polishers and so on.

Power transformer manufacturers and public utilities find sound-level meters useful in determining the noise level of their products. Further applications are in aircraft, automobiles, ships and motor cruisers, where the aim is to keep as much noise as possible from the passenger. Finally, sound-level meters are used for testing the acoustical damping of materials like glass fibre and aluminum. ★

Gas turbine cars

(Continued from page 31)

turbine and heat exchanger.

The Ford Motor Company in one of its rare references to turbines has guessed that it will be about 10 years until the new engines can be put into general production for passenger cars. At the same time, the company has affirmed its confidence in the engine as one that can compete with orthodox internal combustion. "We believe," says its chief researcher A. A. Kucher, "that if a complicated . . . internal combustion engine can be built as cheaply as it is, the future gas turbine . . . will be produced at lower cost."

Cost is the big problem. Claims Chrysler's George Huebner Jr., "We could probably build a marketable turbine auto today. But it would leave a lot to be desired and it would be fantastically expensive."

Looking back at the many past achievements of the auto makers, few doubt that gas turbine costs will somehow be brought into line. It is just a matter of "How long?" Rumours in the industry make it look as if Chrysler may force a faster pace than some manufacturers want. Ten years is probably the outside guess. Certainly, before that time has expired, the present few turbine cars on the road will have become many whether these are for private sale or not. ★

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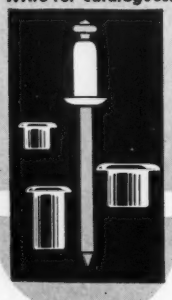

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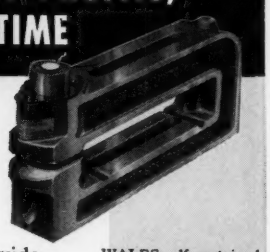

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Editorial

Why not tell the commission?

MOST READERS will remember the message given by R. M. Fowler, President of the Canadian Pulp and Paper Association, to the Gordon Commission in January. In 50,000 words, Mr. Fowler put forward an argument which was as deplorable as it was long and which was as long as it was out of date. It was a plea for the slowing down of secondary industry in favor of intensified raw-material trading; it urged, in effect, that we should cut back on manufacturing to give us more time for digging.

But now it seems that Mr. Fowler has been a good friend to secondary industry after all. For what happened after his brief was made public? People in many (and sometimes unexpected) places rose to protest the folly of this point of view. By an ironic twist, an attack on industrial progress made the nation at once aware of the need to guard its manufacturing future carefully. Mr. Fowler, who is an influential man, lost the day; it became clear that no-one, however strong, can make Canada wonder again if the extractive nation she once was is her proper place in life.

One voice of special engineering interest belonged to Dr. G. Ross Lord. Speaking for the Association of Professional Engineers of Ontario, Dr. Lord read an official brief to the Gordon Commission. Now he added a quickly prepared postscript denouncing Mr. Fowler's point of view with the explanation that, "such an attitude can only lead to industrial suicide and stifle the research and development prowess which Canada today is displaying in a very marked degree."

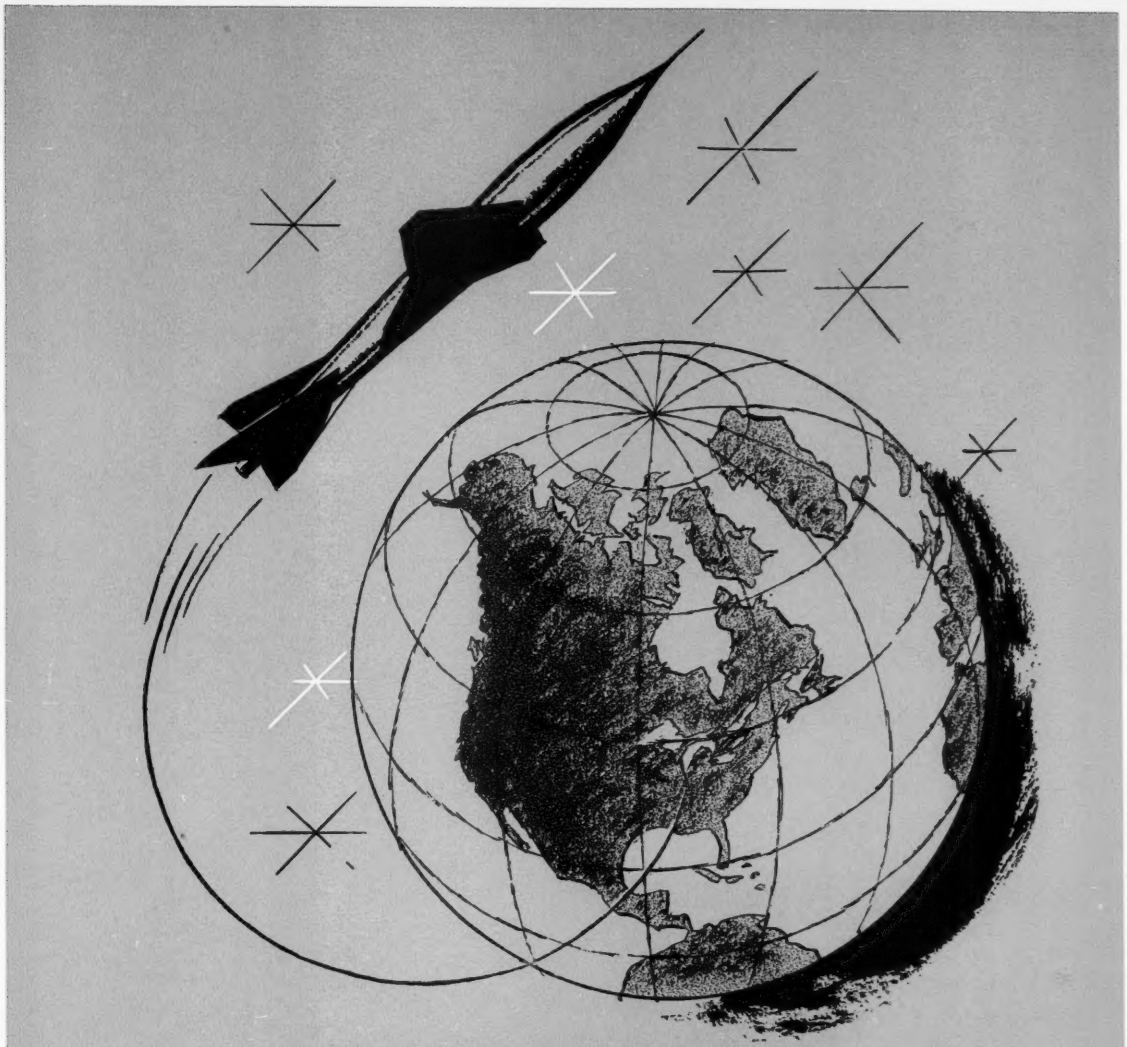
There are two points of unhappy interest in Dr. Lord's statement. First, it was his only (and therefore APEO's only) reference to the importance of research and development work; and second, it was surely too optimistic to act as a warning.

The Association's brief restricted itself entirely to education. It pointed out that enrollment of applied science students is expected to double by 1965 and that accommodating them properly will run up a bill of some $14 millions a year for several years. No-one will doubt that this is shaping up as a serious and disturbing problem and, since Dr. Lord is also a university professor, the brief was in good hands.

But education has to be supported by the opportunity to put knowledge to work later on. Canada is not moving fast enough toward acceptance of the idea that fuller development work must be pushed forward if our industries are to build a durable prosperity and if graduating students are to find rewarding work to do. Nothing could be more squarely part of Canada's economic prospects than this—and it is economic prospects that the Gordon Commission is expressly set up to explore. Yet the Association had nothing to say on the subject at all. Or that, at any rate, is how it was to be until Mr. Fowler forced a postscript retort.

What a pity that even this retort should carry optimism instead of concern to the Commission's hearing. For Canada's research and development prowess is not on display "in a marked degree" at all. It is true that progress is being made—that defense needs have involved some thorough research and that a few isolated manufacturers are making development pay. But it is not true that our industry, in general, is finding its own way.

It is to be hoped that the Gordon Commission somehow gets hold of one simple message among the many complex ones it is hearing. Simply that Canada's industrial future will remain in doubt until independent design has taken control.



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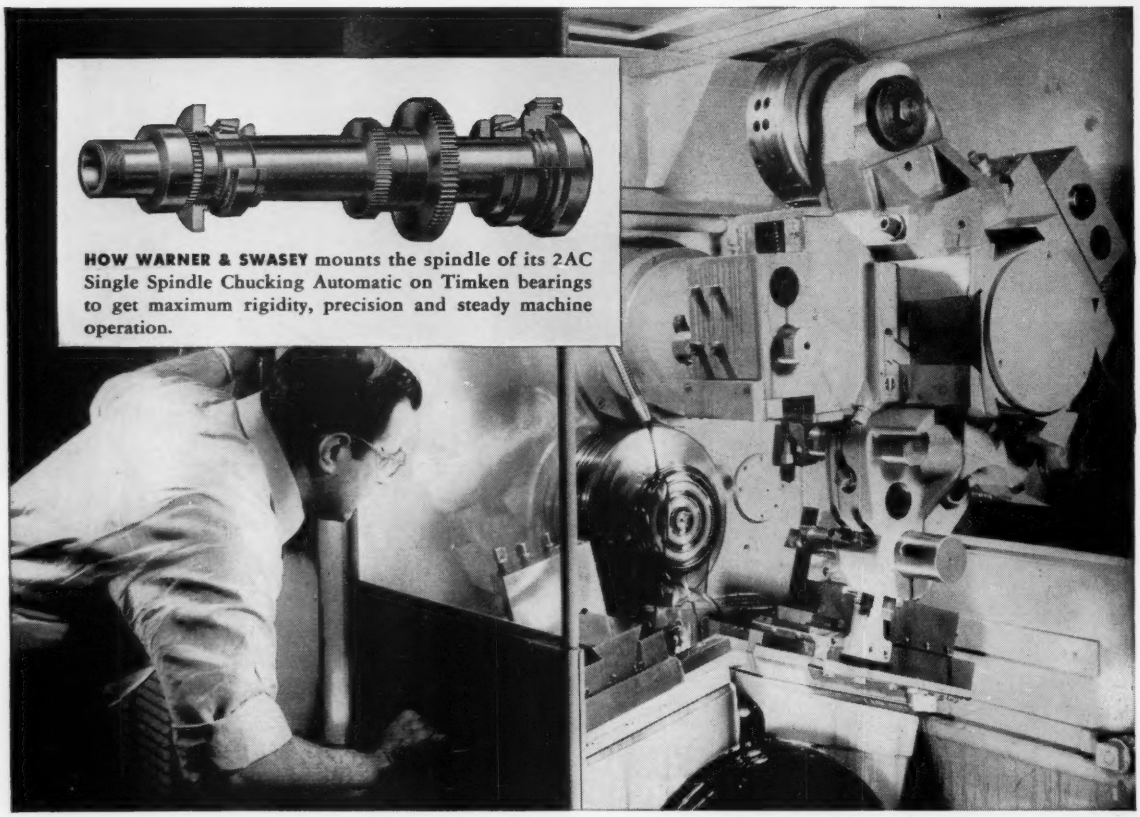

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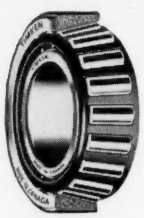

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